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PORCUPINE MINING DISTRICT

The Canadian Mining Journal's Porcupine Series

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VOLUME I

1911
PUBLISHED BY THE CANADIAN MINING JOURNAL
ROOMS 17-23 MANNING ARCADE ANNEX, TORONTO, ONTARIO

Porcupine Mining District

The Canadian Mining Journal's Porcupine Series

VOLUME I

A Series of Illustrated Articles. Accompanied by a Complete Geological Map and Claim Maps of the Various Townships.

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INTRODUCTION

The first press reports about Porcupine were received with the silent skepticism that is born of experience. The unfortunate history of Larder Lake—a district, incidentally, that has never received fair play—was too fresh in the memory of mining men to permit of enthusiasm being roused. Thus the pioneers of the Porcupine district were left for some time in splendid isolation.

While this was wholesome morally, it was not encouraging. The nomadic prospector depends upon the public to pay his shot. He has no desire to operate — he merely wishes to discover, to make his "stake," and to have done with it. In Cobalt he did this. In Porcupine he found the situation much more complicated. The investor had a bitter taste in his mouth and did not intend to be guilty of certain indiscretions that marked the birth-throes of Cobalt. Nevertheless, a number of ready sales took place. Companies and syndicates were organized post-haste, and the promoters did not suffer. But in the greater number of cases the investor held aloof. The consequence has been that the majority of Porcupine flotations have been engineered with a view to taking in immediate profits. This phase is remunerative to the individual, but most costly and unbusinesslike so far as Porcupine is concerned.

Cobalt, when it was discovered, met with a very cold reception from mining men. As soon, however, as actual shipments of ore were made, recognition came with surprising rapidity. Then followed a period during which those whose judgment had been at fault sought to vindicate themselves by throwing cold water on the camp. But Cobalt, despite all captious critics, made good.

Cobalt brought into play much more prospecting and mining talent than could well be taken care of. Hence it was natural that many individuals should seek new fields. New fields were sought and were found. Porcupine was the first fruit.

In its first position Porcupine was between the deep sea of popular incertitude and the devil of promoters' bombast. As to the real character of the ore bodies there was room for scientific discussion. But the atmosphere is now clear, at least geologically. The prompt

and effective work of the Ontario Bureau of Mines was of inestimable value to the camp. The advent of substantial foreign interests is to be credited to the Bureau's timely activity.

So vigorous was the early prosecution of mining in Porcupine that the Ontario Government decided to build to the camp a branch line of the Temiskaming and Northern Ontario Railway. This line will be finished during the coming summer. Naturally it will mean much to the district. Only those who worked their way over the summer trail last year can realize how severely Porcupine operators were handicapped by the lack of transportation facilities. The fact that teams were hired for as much as $25 per day gives some idea of the situation. But by far the worst obstacle was the bad mail and telegraph service. The exigent terms imposed upon buyers made it almost impossible to investigate mining claims sufficiently. It can readily be imagined that a delay of one or two weeks in transmitting a letter from Porcupine to Toronto, Montreal, or New York might imply the difference between success and failure in putting through a mining deal. In any case, the general tendency would be to come to a decision that was unwarranted by existing conditions. Now, however, since Porcupine will have all the advantages of modern communication, it is entirely possible to investigate fully any claim. This will temper the tone of promotion.

* * * * *

Ontario has had a very bad name in gold mining. The contributing factors in this bad name are too numerous to mention. But the prime fact is that the gold mines of the province have never been worked on their own merits. There has been far too much booming and promoting, and far too little ready money and common-sense. The Lake of the Woods region, for instance, had much to recommend it. Probably to-day money could be made out of several of the properties that have been labelled failures. But the district has lost favour in the eyes of prospectors and operators. This is true of more than one gold-mining section of Ontario.

Except for the Yukon excitement, no such widespread interest has ever been stirred up in Canada by the discovery of gold. Quite apart from any direct profits that may accrue to operators in Porcupine, the advertisement to Canada generally and to Northern Ontario specifically, is of enormous value. Following so closely upon the exploitation of Cobalt, the opening up of Porcupine has kept Northern Ontario continuously in the lime-light. It has strengthened decidedly the belief that there are yet many prizes to be won in the hinterland of Ontario and the adjoining area in Quebec. An illustration of this is afforded by the large amount of staking that just now is being done on the territory surrounding Keekeek Lake, Pontiac County, Quebec. Humanly speaking, it is improbable that attention would have been

paid to this remote spot for some time to come had it not been for Porcupine.

Study of the mining situation in Ontario, brings the conviction that only the fringe of the northern mineral belt has been touched. The summer of 1911 will see more prospecting done than ever before. Succeeding seasons will bring more men and more money to the country. It is absolutely within the range of probabilities that other Porcupines will be discovered. If Porcupine lives up to its promise, then Ontario will have received an unprecedented commercial impetus. Moreover, the wave of development will spread through to Quebec. Farming will follow hard upon the heels of mining. Thousands of square miles of arable land will be thrown open to the farmer and a permanent population will be established.

Considering the large number of bona fide investments that have been made in Porcupine, it behoves mining men to do what in them lies to disseminate right information and to discountenance the wild tales that emanate from all irresponsible sources. In whatever way Porcupine may develop, it now seems that in a few mines money will actually be made. But many more may prove profitable if initial sales and promotions are handled decently. In other words, sane exploitation will give the camp a maximum chance; frenzied speculation will shorten the life of individual mines and will injure the camp permanently.

* * * * *

The demand for back numbers of the CANADIAN MINING JOURNAL containing articles on Porcupine has exhausted all available supplies. As that demand shows no signs of abating the publishers of the JOURNAL decided to issue in pamphlet form several of these articles along with other material. The geological map that goes with this book was secured through special arrangement with the Ontario Bureau of Mines. The map has been copyrighted by the Bureau. It is to be noted that the Bureau assumes no responsibility, direct or indirect, for the matter contained in this book. The publishers, however, wish to express their warm sense of gratitude to the Bureau for the courtesy extended.

It is hoped that the information contained in the succeeding pages will prove a useful guide to professional men and investors.

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Discovery of Porcupine

The discovery of Porcupine was the result of well directed effort. Some years hence when Porcupine may have realized to a small extent the fanciful dreams of the prospect owner of to-day, the story of its discovery may be shrouded in mystery. It is well, therefore, before the romancer has had an opportunity to obscure the facts, to record the authentic details relative to the discovery and opening up of this promising district.

It is interesting to know that the prospecting resulting in the discovery of the Porcupine district, was inspired by a perusal of the reports compiled by the Ontario Bureau of Mines. The suggestion implied in this statement might with much profit be applied both in impelling and restraining effort in this field of endeavour. The Bureau reports are invaluable to those who intelligently engage in search for minerals.

The report of the Bureau of Mines of 1899, contained a paper by Dr. W. A. Parks, dealing briefly with certain geological characteristics of the Porcupine district. The report suggested that the district was worthy of exploration for the discovery of gold. Mr. H. F. Hunter, of Toronto, who had for some years been interested in mining, after reading this report was particularly attracted with the possibilities of the district, and decided to prospect it. In the summer of 1907 Mr. Hunter's prospecting party, in charge of Jas. J. Dwyer, a well known north country prospector, proceeded to this district, remaining until late in the autumn. On the west shore of Porcupine Lake, on the properties now owned and operated by Porcupine Lake Gold Mines Limited, they made their first discovery.

To give interest to the story some of the difficulties of the prospector should be told. The trip out was deferred as late as weather would permit. On the way the canoes of the party had to be abandoned, and before reaching the railway, blankets, supplies, everything, in fact, except the samples that were collected, were left along the trail. Dwyer's samples of ores and of country rock so impressed Mr. Hunter that he was determined that a winter trip should be undertaken in order if possible to learn at once something definite of the chief discovery.

In January, 1908, Dwyer, with four men, left Matheson, then the end of steel, and a trip was begun that contrasts strangely with the present journey to Porcupine. It took 22 days to reach Porcupine Lake (the Pullman passenger will soon cover the distance in less than two hours). Tents were pitched on the lake shore, and then began the initial developments of Porcupine's first gold discovery. Not

until Mr. Hunter's arrival in the latter part of the following April did Dwyer see a new face at his camps. Mr. Hunter describes the last stage of the journey from Night Hawk Lake to Porcupine Lake, a distance of about 10 miles, as taking from two o'clock one afternoon until eight o'clock the following evening. The details may well be left to the imagination. One trip across country was enough, and after an enforced wait at his camps during the break-up another overland trip was avoided by the building of rafts. With these the trip down Porcupine River carrying several hundred pounds of ore, was undertaken. Reaching Night Hawk Lake, the canoes abandoned the fall before were picked up, and the journey to the railway easily completed.

Two other visits were paid to the property by Dwyer, and another by Mr. Hunter in the spring of 1909. By this time a considerable amount of deep trenching had been accomplished; but heavy drift and deep capping over the vein made surface work as a means of tracing the ore body, too difficult for a small gang of men. The footwall having been uncovered near the water's edge, a test pit about nine feet deep was sunk on the ore body between this and the lake shore line. Altogether, enough work had been accomplished to disclose the character and value of the ore. This caused Mr. Hunter to decide temporarily to abandon the work, and to construct a winter road for more extensive development of the property.

Jack Wilson, and later Geo. Bannerman, came along shortly after Dwyer and his party had left. They found Dwyer's tents untenanted. They were surprised to discover a blacksmith shop and coal in that inaccessible region. They saw at once that prospectors had succeeded in discovering visible gold. Inspired by this incident, in a short time Bannerman had staked the property now known as the Scottish Ontario, and, later, Wilson staked the Dome. Meanwhile, specimens from Dwyer's discovery were being shown in Toronto. From that time on the interest in Porcupine grew. The Dunlap-McMartin-Timmins group became interested, securing an option on the properties now known as the Hollinger. Work on the winter road was rushed. Porcupine became easier of access, and its subsequent history and development are well known. The widespread attention being given the camp to-day, and the strong showing on some of the properties under development, must be exceedingly gratifying to those who were identified with the earliest stages.

"Notes transcribed from first Edition Ontario Bureau of Mines Porcupine Map."

The strike of the schists is shown by the direction of the white lines. The term rhyolite is used for the fine-grained varieties of quartz-porphyry. Schists occur in greatest volume, but the quartz-porphyry is at times fresh and massive with little or no schistose texture. The relation of the quartz porphyry and amygdaloidal basalt has not been determined on these lots, but in other parts of Porcupine the quartz-porphyry appears to send dikes into greenstone-schists. Associated with the quartz porphyry and rhyolites are fine-grained, grey-coloured, sericite schists which are probably these rocks in an altered state. The boundaries of amygdaloidal basalt shown on the map are approximate and include some areas of fine-grained, grey, schistose rocks which may be altered rhyolites. Amygdaloids are typically developed on the north part of the northwest quarter of the south half of lot 10, concession II. Fresh quartz-porphyries may be seen on the McEnaney property, especially at the quartz vein near the northeast part. Somewhat massive rhyolites occur southeasterly from Miller Lake.

Some of the schists are impregnated with iron pyrites and ferruginous dolomite, which at the surface causes the rocks to weather to a rusty brown colour due to iron oxide. The following analysis of the schist at the office of the Timmins mine was made for the purpose of determining the amount of carbonate present. The high per cent. of C O_2, namely, 11.69, robs the analysis of its value in determining the igneous or sedimentary origin of the rock by chemical criteria. The composition of the schist is: Si O_2, 39.39 per cent; Fe_2 O_3, 2.62 per cent.; Fe O, 13.78 per cent.; Al_2 O_3, 17.95 per cent.; Ca O, 7.52 per cent.; Mg O, 0.87 per cent.; Na_2 O, 1.93 per cent.; K_2 O, 0.96 per cent.; Ti O_2, trace; C O_2, 11.69 per cent.; H_2 O, 3.20 per cent.

Further stripping, in certain cases, may prove that some of the ore bodies are more continuous than they are shown to be on the map. They are composed of white quartz having at times a bluish tinge. The following minerals occur in subordinate amount:—Calcite, dolomite, light grey feldspar, sericite, talc, chlorite, tourmaline, iron pyrites, copper pyrites, and specks of galena and zinc blende. The occurrence of feldspar is interesting because it shows the deposits are related to granite or pegmatite dikes, and, in fact, specimens may be picked out here and there which have the composition of granite. The irregular and very lenticular nature of the occurrences may be more readily understood when looked at from this point of view, because granite pegmatites

sometimes have such irregular boundaries. The veins for the most part cut across the schist and hold fragments of it. Native gold occurs in the quartz and closely associated with the sulphides, but much appears to have been deposited along small cracks or slickensides. In these cracks or slickensides sericite and other minerals occur and probably also parts of the altered country rock.

KEEWATIN.—The Keewatin rocks are both massive and schistose, with the latter predominating. The oldest rocks are greenstones (basalts, etc.) and green schists. Ellipsoidal or pillow structure in the greenstone may be seen on the Dome property on the southwest part of the northeast quarter of the north half lot 5, Con. I., and altered amygdaloidal trap occurs in the same locality. Quartz-porphyry is quite abundant in parts of the area and passes gradually into a schist which retains the small phenocrysts of clear quartz.

Extending from the Dome to the Foster in a general east and west direction are highly metamorphosed dark and light coloured schists of uncertain origin, but which are considered to be of Keewatin age. In addition, there are other schists which are highly impregnated with ferruginous carbonate and weather to a rusty brown. In places the carbonate constitutes the bulk of the rock.

HURONIAN.—The Huronian consists of greywacké, slates and conglomerates, which are in part greatly altered, and the conglomerate pebbles are drawn out in the direction of schistosity. Near the Dome camp the original bedding of the sediment can be recognized in the greywacké. Similar rock occurs just north of the compressor and 5 chains east of No. 4 shaft. Associated with the greywacké are some highly altered schists and conglomerates. In the conglomerate north of No. 2 shaft are pebbles of porphyry, greenstone, quartz and iron ore. No granite pebbles were seen in the conglomerate.

As the Huronian rocks have the same strike and dip as the Keewatin and are also greatly altered, it is extremely difficult to make a separation with certainty, but an attempt has been made to group the greywacké and conglomeratic material with the Huronian. Later it may be shown that some of the conglomerate is autoclastic.

VEINS.—Quartz veins occur on the Dome property in both the Keewatin and the Huronian. There are several large dome-like masses of quartz which meet the schist at a low angle, and many narrow veins of quartz which have a higher dip and distinctly cut across the strike of the rocks. Visible gold is seen at a number of points in the quartz. It is associated with iron pyrites and small quantities of copper pyrites, galena, and zinc blende. The schist near the veins is impregnated with cubes of iron pyrites, and is reported to carry some values in gold.

On the Foster properties the vein known as the "Curts" consists of a ferruginous carbonate (ankerite) which is cut by numerous quartz stringers, most of which occur transversely to the strike of the vein. The carbonate has been partly leached out and is now stained by a bright red hematite which, with the ribs of white quartz, gives a striking appearance to the vein. This vein, which at one point has a width of 22 feet, has well-defined schist walls, strikes nearly east and west, and dips steeply to the north. Visible gold occurs at several points in the quartz and carbonate. Iron pyrites accompanies the gold in this vein. The

veins on the east Foster claim are similar in character to the one just described, but are much smaller.

HISTORY OF DISCOVERIES.

Until the last two or three years the Porcupine area was difficult of access and little prospecting was done in it. The information concerning it was practically all contained in the reports published by the geologists who accompanied O. L. S. Niven in his base-line work and the township surveyors in the years 1896, 1898, 1899, 1903, 1904 and 1905. In 1896 Mr. E. M. Burwash accompanied Mr. Niven as geologist in the survey of the Nipissing-Algoma boundary line, which, it may be added, now forms the boundary between the districts of Nipissing and Sudbury. The boundary was run northward to mile 120, which is now situated at the southeast corner of the township of Whitney, and the eastern boundary of the township of Shaw includes that part of the line lying between mile 114 and mile 120. Mr. Burwash's description is published in Volume 6 of the Report of the Bureau of Mines. He points out that the district gives promise as a gold field. The following extracts are taken from his report, pages 180, 181 and 183:—"Near the 116th mile the line finally passes off the granite and intrudes upon grey slate rocks. On the first half of the 116th mile (now on the eastern boundary of the township of Shaw) a small quartz vein occurs, which, on assay, was found to contain a trace of gold . . . . The district would be a promising one from the prospector's point of view were it not for the presence of the drift . . . . In the lower parts of the series (Keewatin), on the other hand, gold appears to be quite widely distributed, both in veins which are of tolerably frequent occurrence and in mineralized portions of the rock itself . . . . In two cases the veins were situated near the boundary of granite areas. In two localities, between the 85th and 95th miles, the gold occurs in mineralized bands of the country rock, which in both cases is more or less chloritic."

In 1898 Mr. W. A. Parks reported on the geology of the district for the Bureau of Mines. His paper is published in Volume 8. Mr. Parks noted the occurrence of gold in traces in some of the quartz veins, and said:—"I regard the region south of the trail to Porcupine Lake as giving promise of reward to the prospector." Interesting reports on the district including or adjacent to Porcupine were later made for the Bureau of Mines by Mr. Geo. F. Kay, Mr. James G. McMillan and Mr. H. L. Kerr, whose reports are published in Volumes 13, 14 and 15 respectively of the Bureau of Mines.

The first prospecting in the area appears to have been done in 1906, when a shallow pit was sunk on a claim adjacent to what is now known as the Timmins mine. The next work in the area was done by Mr. Hunter on the eastern shore of Porcupine Lake. The vein uncovered here shows gold in hand specimens. In 1909 interest was revived in the district by the discoveries of Mr. J. S. Wilson and others. Mr. James Bartlett, one of the Bureau's geologists, made a brief examination of the discoveries in October and a report by him was shortly afterwards made public.

TOPOGRAPHY AND GEOLOGY.

Much of the surface of the area is low and wet, although it can scarcely be said to be swampy. The lower flat surface is occupied by

well-banded clay, together with some sand and gravel. Overlying the clay is a layer of vegetable mould from a few inches to a foot or more in thickness. This layer holds water, the underlying clay being impervious, and presents a surface somewhat difficult to drain. Outcrops of compact rock occur irregularly over the surface covering. Since some of them are small, they are difficult to locate. In some sections of the area the rocks rise into ridges which extend across parts of several lots. In most cases the rocks do not rise to a greater height above the general level than 50 feet. Occasionally, however, they rise to heights of 100 to 150 feet.

The area lying between the mouth of Porcupine River and Porcupine Lake has a maximum elevation of about 970 feet.

The southwestern part of Tisdale is considerably higher, reaching an elevation of about 1,100 feet.

The lakes are shallow and the rivers have cut deep. The greatest depth of water found in Porcupine Lake was 20 feet. Night Hawk Lake has only 6 feet of water in many of the wide parts, and 12 feet was the maximum depth found.

KEEWATIN.—The oldest series, the Keewatin, is similar in character to rocks of this age found in various parts of northern Ontario, from the Quebec boundary on the east to that of Manitoba on the west. They consist of various volcanic rocks, with their schistose representatives. The series is here much more disturbed, as is illustrated by the schistose character in many places, than it is in the Cobalt area. In the Porcupine area, however, some of the Keewatin rocks have escaped dynamic metamorphic agencies sufficient to show their original character. In parts of the township of Whitney and elsewhere, for instance, certain basalts still retain quite perfectly their amygdaloidal texture and ellipsoidal structure. Most of the Keewatin in the Porcupine area, as elsewhere, consists of dark-coloured or greenish, massive or schistose rocks of basic or intermediate composition. Quartz-porphyry is, however, a rather common rock in the Porcupine area. While it occurs characteristically in dikes, it is also found in larger masses. Certain quartz-porphyry dikes have been subjected to pressure and broken up, and now resemble conglomerate. The metamorphic action has produced a dark greenish base, through which are set fragments of the porphyry. Probably volcanic fragmental rocks of Keewatin age occur in the area, but they have not been definitely recognized.

Associated with the Keewatin, especially in the southern part of the township of Whitney, there is much iron formation. This iron formation is commonly called jaspilyte, and consists of alternate thin bands of magnetite and silica, the latter being frequently red in colour. Many of the Keewatin rocks contain considerable carbonate—calcite, dolomite or a ferruginous carbonate. In some parts of the area are masses of rock essentially composed of these minerals, giving rise to crystalline limestone, which is usually rusty-weathering. Such an occurrence is found on the northern part of lot 10 in the sixth concession of Whitney township. This outcrop covers an area of 12 or 15 acres and is not seen in contact with other rocks. It may correspond in age to the crystalline limestone of the Grenville of eastern Ontario. In the vicinity of the Dome mine there is an outcrop of a ferruginous carbonate. It would appear not unlikely that carbonate in some places is a replacement mineral, and

that a considerable volume of rock may at times have been replaced by the carbonate. A ferruginous carbonate, not unlike that in rock masses, occurs as veinstone in a few cases. For instance, the strong vein on the Foster and adjacent claim is composed of a ferruginous carbonate that has been fractured and filled in with quartz; an analysis of this carbonate shows it to have the following composition: Ca O, 28.68 per cent.; Mg O, 14.20 per cent.; Fe O, 8.66 per cent.; C O_2, 43.14 per cent. A somewhat similar carbonate occurs in a vein on the Gray claims in the township of Ogden and an analysis shows its composition to be: Ca O, 23.97 per cent.; Mg O, 9.46 per cent.; Fe O, 10.36 per cent.; C O_2, 34.94 per cent.

The Huronian in this area has been subjected to intense dynamic metamorphism, and it is difficult to distinguish Huronian schist or other highly metamorphosed rocks of this age from the Keewatin. One of the most difficult problems of the pre-Cambrian is to distinguish, when dynamic metamorphism has taken place, true fragmentary, especially conglomerates, from volcanic fragmental material, or from friction breccias, which are commonly called autoclastic rocks. In some areas doubtless each of these three classes—(1) true conglomerates, (2) volcanic fragmental material, (3) friction breccias or autoclastic rocks, may be present. Then the pre-Cambrian geologist may be excused if he makes a mistake.

Laurentian.—The map shows a few outcrops of granite in the southern part of Whitney township. This granite, a biotite granite, is somewhat fine in grain and intrudes the Keewatin, but its relation to the Huronian has not been determined. It is classed provisionally as Laurentian, although it is not characteristic Laurentian granite. Granite is known to occur in large volume a few miles beyond the boundaries of this map. Later editions of the map, it is hoped, will show the relationship of the granite to the other rocks of the area.

Huronian.—A belt of Huronian fragmental rocks, that outcrops through the drift covering at irregular intervals, has been traced from near the mouth of the Porcupine River in the township of Cody southwest across the northern part of the township of Whitney and southwest through Tisdale. As previously mentioned, the Huronian has been subjected to great metamorphism and in places it is rendered highly schistose. Its metamorphism here is in striking contrast to that of the same series in the Cobalt, Gowganda, and other areas to the southward.

The three facies of the series characteristic of the areas just mentioned are found at Porcupine. There is conglomerate, impure quartzite or more massive greywacké and well-banded slate-like greywacké. Where the Huronian rocks have been rendered schistose, their recognition is assisted by the occurrence of these facies. It is difficult in some cases, as has been said above, to distinguish metamorphic conglomerate from volcanic fragmental or autoclastic rocks, but the more slate-like facies of the Huronian tend to retain their original character more perfectly and are less apt to be mistaken for, or confused with, Keewatin rocks.

Olivine Diabase.—Several dikes of olivine diabase, cutting the Keewatin, have been found in the area. These dikes are similar in character to the well-known dikes of Sudbury and to one or two that have been found in the Cobalt and Gowganda areas. The olivine diabase

in the Porcupine area is considered to be of post-Middle Huronian age.

Glacial and Recent Deposits.—It is not necessary to say more concerning the glacial and recent deposits of the district than has been said above.

ORE BODIES.

Outcrops of quartz are very numerous in the area mapped. They are found both in rocks of Keewatin and Huronian age. The age of the rock, whether Keewatin or Huronian, does not appear to have any bearing on the character of the vein, either as to form or as to gold content.

While the field work has not extended over a large enough area to include the granite mentioned above, the writer has little doubt that the quartz deposits of the Porcupine area are connected with the great granite intrusions which took place in post-Lower Huronian times. The quartz has been deposited from the impure waters, highly heated and under great pressure, which worked through the rocks after the granite intrusion.

At the time the field work in connection with the preparation of the first map was in progress, development work on the ore bodies was only in preliminary stages, and facilities for the study of ore deposits were naturally not good. Moreover, it may be said that our object was to prepare a map for the use of the prospectors and to make a more detailed study of the ore bodies later on. The detailed maps of Messrs. Knight and Burrows, which accompany this general geological map, show the occurrence of some of the important ore bodies. It is seen, for instance, that the ore bodies at the Timmins cut across the strike of the schist, and that they vary considerably in width from point to point. This is characteristic of practically all the ore bodies in the area. They widen into large masses of quartz, in one or two cases from 75 to 100 feet in width, and narrow abruptly. Mr. Knight, in the notes published with his detailed plan, refers to this, and compares this abrupt change to that which is frequently seen in granite pegmatite. The Foster vein, mentioned above, differs from the quartz veins or deposits to which reference has just been made.

Microscopic Examination of Some Typical Specimens of Porcupine Rocks and Vein Matter.

[Editor's note: The following article was prepared for the CANADIAN MINING JOURNAL by Mr. John Stansfield, B.A., F.G.S., of the Department of Geology, McGill University. The hand specimens from which the slices were prepared were selected by the Editor, under the guidance of Mr. Myles Flynn, through whose kindness it was possible to secure a representative lot. All the specimens were taken from the Vipond mine, largely for the reason that on this claim nearly all the characteristic types of ore and country rock are to be found within small compass.

Whilst each microphotograph has its own particular significance, the general conclusions adduced by Mr. Stansfield are noteworthy. That the carbonates are older than the quartz is demonstrated. That the quartz is of igneous origin is indicated. The presence of feldspar shows a relation of the vein matter to aplite, and, as Mr. Stansfield points out, the presence of tourmaline tends to confirm the idea of the igneous origin of the vein matter.

Another fact adduced may be of decided moment. The gold and pyrites were evidently of contemporaneous origin, although some of the gold was deposited at a period later than the pyrites.]

Pure Siderite, No. 2 Vein.

A dark, bluish gray quartz band, bearing pyrites, cutting a dark brown carbonate, stained by limonite. The carbonate is siderite, bearing traces of calcium, and magnesium. By weathering it is partly altered to limonite. The quartz vein is accompanied by a vein of ankerite. A slice of the quartz-ankerite vein shows dirty carbonate —the ankerite cut by thin veins of clear carbonate, and also by veins of coarsely and finely granular quartz, which has liquid inclusions containing gas bubbles. The carbonate is also found scattered through the quartz veins, but especially at their edges. A few crystals of pyrites occur in the ankerite and often have a little quartz in contact with them.

A slice of the dark brown carbonate shows yellow siderite cut by a vein of quartz. The quartz is usually coarse in grain and full of liquid inclusions, which have gas bubbles, some of them being in motion. The quartz contains some of the siderite in a clouded condition. Some of the quartz grains have a slight chloritic film round them. The siderite is finely granular and towards the quartz vein becomes more and more clouded with a fine dark brown dust, becoming almost opaque at the edge of the vein. The clouding is due

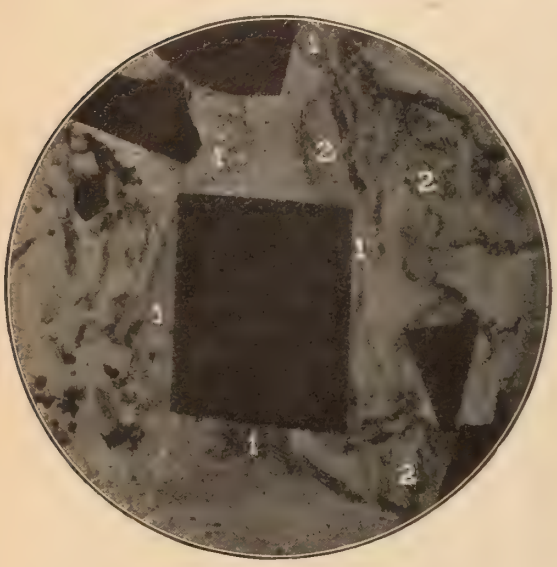
to the production of limonite, which appears to be directly connected with the introduction of the quartz vein. Some small quartz grains are found distributed through the siderite.

No. 3 Footwall Pay Streak—Pit 300 Feet East of Ward Pit.

See Fig. 1.

White quartz with dark green richly pyritic bands, some narrow bands rusted and showing free gold. Some surfaces show chloritic-sericite schist development.

The mass of the rock is quartz which is shot through in all directions by carbonates and fine-grained quartz and also by more definite veins characterized by fine-grained quartz, pyrites, chlorite and sericite. The sericite and chlorite are usually seen wrapped round the pyrites crystals, which are large and well-shaped. The carbon-



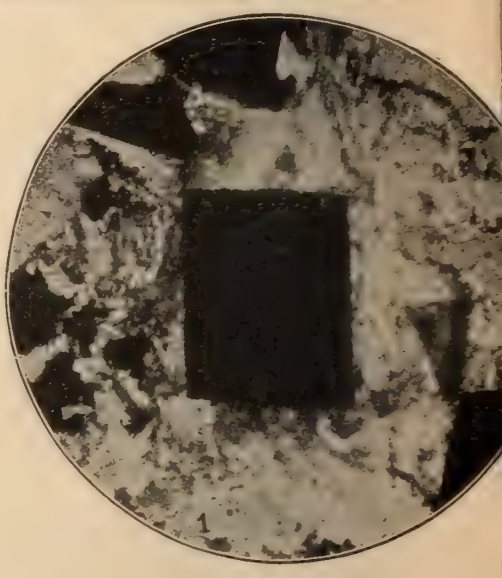


Fig. 1. Nicols.

1. Chlorite. 2. Sericite. 1. Quartz.

Shows films of chlorite wrapping round pyrites crystals in a rim of sericite in Quartz.

ates are dirty and are often iron-stained. The quartz grains sometimes have films of chlorite between them and chlorite is seen through the slice outside the veins, but in small amount only.

Vein Matter—Green is Characteristic of Whole District, Only Associated with Carbonates.

See Fig. II.

Gray banded rock, bands of bright green often associated with pyrites, bands of yellow carbonate and bands of quartz. Some surfaces are shiny, showing sericite.

The rock is rich in carbonate and in quartz. Pyrites in large irregular masses of crystals is developed along bands. The green matter is chlorite, which is developed along bands and always associated with sericite in greater or less quantity. The chlorite shows a

slight pleochroism, from green to yellow. A considerable quantity of feldspar occurs, including both orthoclase, with twinning on the Carlsbad law, but more frequently plagioclase, twinned according to the albite law, and some laths untwinned. The plagioclase is of a basic oliogoclase variety . Extinction angle 16 deg.)

The rock appears to be an altered igneous rock which has been impregnated in all directions by carbonate and quartz. It would appear to have been originally of the nature of an aplite. There is nothing to indicate what was the original mineral from which the chlorite is formed. The sericite, at any rate in part, is derived from feldspar.

Green for Identification.

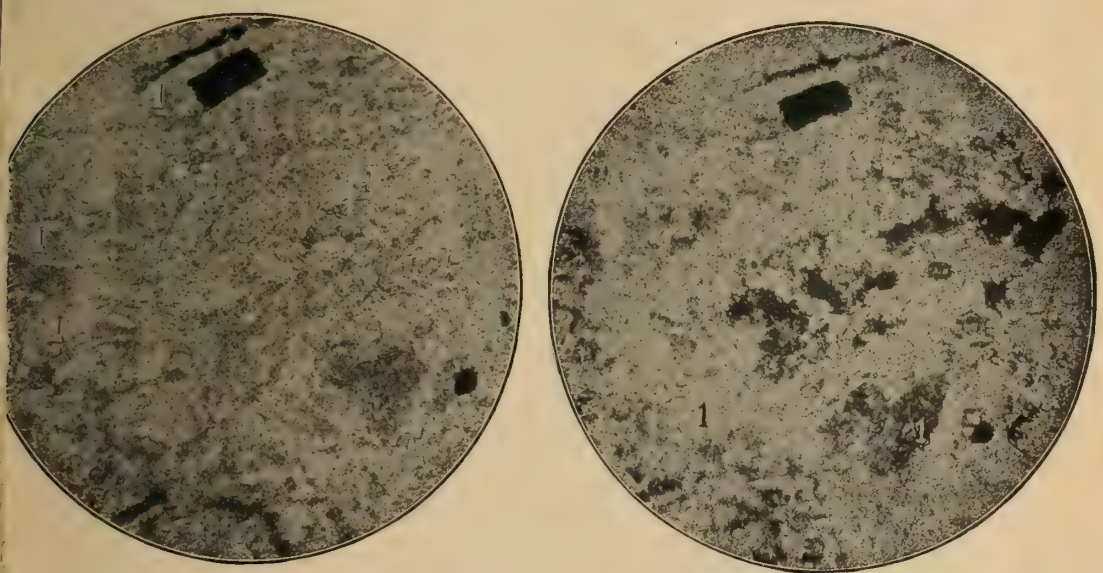
White quartz with green patches. The pyrites occurs in small amount in the green patches. It is now much altered, giving rise to brown iron-staining. A little free gold seen at one point on one of the green veins.

The rock consists of quartz in coarse grains showing strain shadows and very many liquid and gas inclusions. Fine grains occur only in very small amount. Carbonates occur as interstitial patches and as thin films between quartz grains. Chlorite occurs interstitially, usually associated with carbonates. It has a faint greenish colour with very faint pleochroism and is nearly isotropic.

Tourmaline needles of a bluish gray or brownish gray colour are found with arrangement in strings parallel to their length.

A few small patches of gold occur in association with interstitial carbonate and one small crystal of pyrites with interstitial carbonate, chlorite, iron oxide, the latter produced by weathering.

The green is chlorite and tourmaline with a predominance of the former.



1. Sericite Bands. Fig. II. Nicols. 1. Twinned Feldspar.
Shows development of sericite bands in quartz. Two feldspar crystals (oligoclase) are shown. The dark line shows its upper boundary.

No. 3 Vein—Banded Smoky Quartz—Ward Pit West.

See Fig. III.

Quartz rock with darker and lighter bands and thin bands rich in pyrites, with some softer sericitic bands. The hand-specimen shows considerable free gold, which always occurs in connection with the pyrites bands, but just outside them.

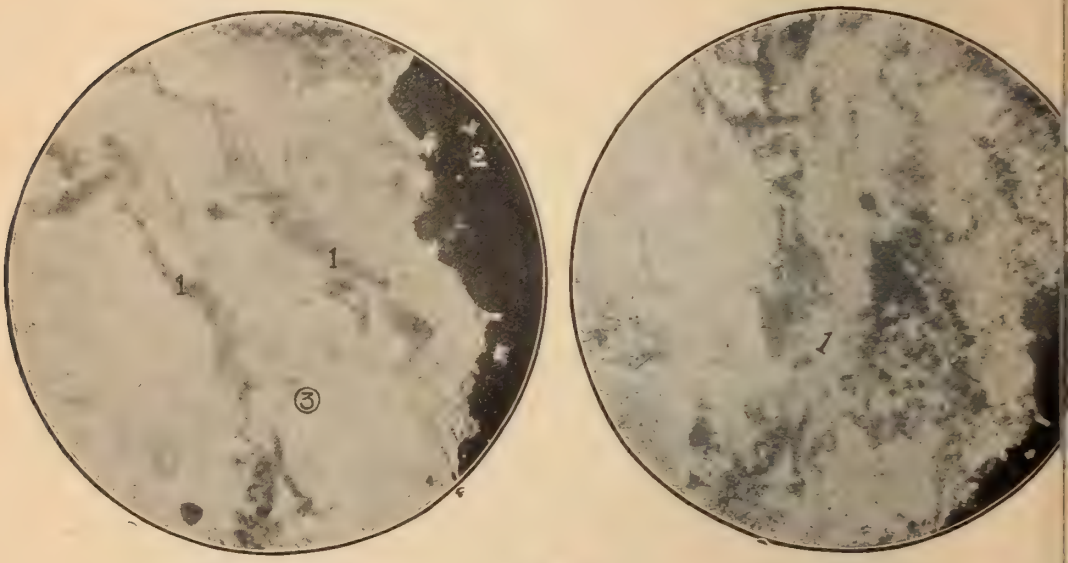


Fig. III.

1. Tourmaline Bank. 2. Pyrites. 3. Sericite Bank. Nicols. 1. Sericite. Shows parallel development tourmaline bands on each side of a sericite band, and of pyrites.

The rock is made up of quartz for the main part, which occurs in coarse and fine grains, chiefly the latter. Some of the grains are elongated and placed with their lengths perpendicular to the faces of pyrite crystals, which often exhibit this phenomenon on all four faces. The quartz is full of liquid inclusions, usually with a gas bubble inside the liquid. The larger grains show strain shadows. Pyrites in large irregular masses of crystals is developed along bands, as are also sericite, carbonate and tourmaline. The tourmaline occurs in small pleochroic needles and is only small in amount. Sericite is more important in amount and forms streaks through the quartz often with no other mineral in it, in other places associated with quartz and carbonates. Carbonate is found scattered throughout the rock.

No. 2 Vein—Banded Quartz and Schist with Sulphides—Fairly Rich in Gold.

See Fig. IV.

A dark-coloured banded quartz-chlorite schist, the quartz and chlorite bands being very distinct. Contains a little pyrites. A fresh fracture shows the greenish colour of the chlorite.

Fig. IV. 1. Carbonate Band. Shows Banded Schistose structure with pyrites in bands. The dark streaks are rich in chlorite, the lighter ones in carbonate.

The thin section shows banded structure and consists of quartz, carbonate, chlorite, sericite, pyrites, and a little tourmaline, in that order of importance. The minerals are arranged in bands and various associations are found, e.g., bands of sericite with tourmaline, of chlorite and sericite, with or without pyrites, of quartz with no other mineral, and so on. The quartz occurs as eyes and is finely granular. Carbonate is found scattered throughout the rock in addition to its parallel arrangement in bands.

The chlorite is in places of a deep green colour for chlorite, and at the same time with more marked pleochroism, from green to yellow, with birefringence and extinction parallel to the lengths of the fibres.

Mixed Sulphide and Ankerite from No. 3 Vein—Gold-Bearing.

See Fig. V.

A gray carbonate rock with much quartz and very rich in pyrites. In some parts it has bands of a sericite schist.

The rock is composed of dirty carbonate in which pyrites is very richly disseminated. It is usually accompanied by quartz which is also scattered through the carbonate. There are quartz veins cutting the carbonate. The pyrites often has good crystal outlines, but also occurs in crystal aggregates. The quartz veins are not rich in pyrites, but the largest crystals occur there. The quartz crystallized in contact with pyrites often shows elongated shapes, the grains being set with their length perpendicular to the faces of the pyrites crystal. The quartz is rich in liquid inclusions, which often have a gas inclusion in them. A small quantity of sericite occurs and is generally found in association with the quartz-pyrites nests, often in

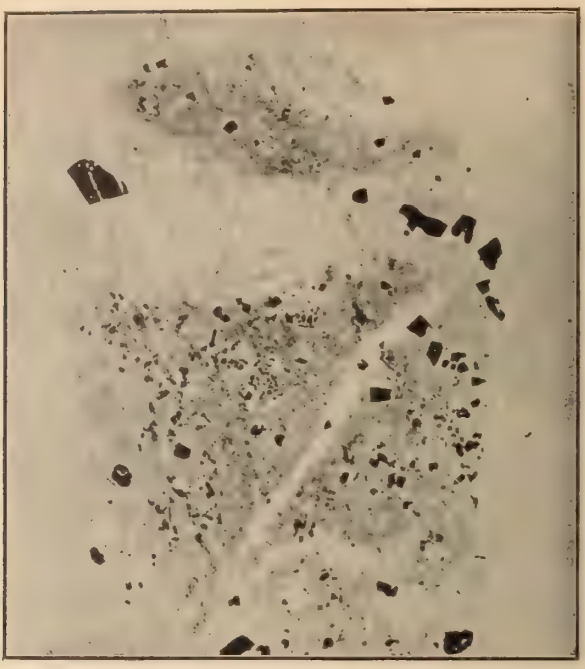


Fig. V.—Veins of quartz cutting carbonate, with rich development of pyrites in carbonate. Largest pyrites crystals are in quartz vein.

direct contact with the pyrites. One small piece of green chlorite occurs surrounding a small crystal of pyrites.

No free gold occurs in the slice.

One or two crystals of feldspar occur in the calcite. It is an oligoclase showing an extension angle of 12 deg.

Fine and Coarse Amygdaloidal Basalt.

See Fig. VI.

A dark green rock approaching a chlorite schist. It has well-marked parallel structure and has elongated amygdales which are filled with carbonates.

The rock is composed of chlorite and carbonate. The carbonate fills up the elongated amygdales, passing into bands. The chlorite is banded and of two varieties, one almost colourless and the other deep green with strong pleochroism (olive green to greenish yellow), and with higher birefringence than is usual in chlorite. It corresponds in characters to clinochlore. The bands are characterized by varying amounts of the two varieties of chlorite and also by sericite, which is also found in bands, but in subordinate amount.

The rock is rich in dark patches of indeterminable matter, white by reflected light. It has rough shapes and occurs in the calcite and chlorite indifferently, most often as a dirty dust.

Black Dolomite from No. 2 Vein Footwall.

A black carbonate rock with siliceous appearance. It has small bands with development of sericite schist.

The rock is composed of carbonate with a very little quartz in small interstitial grains.

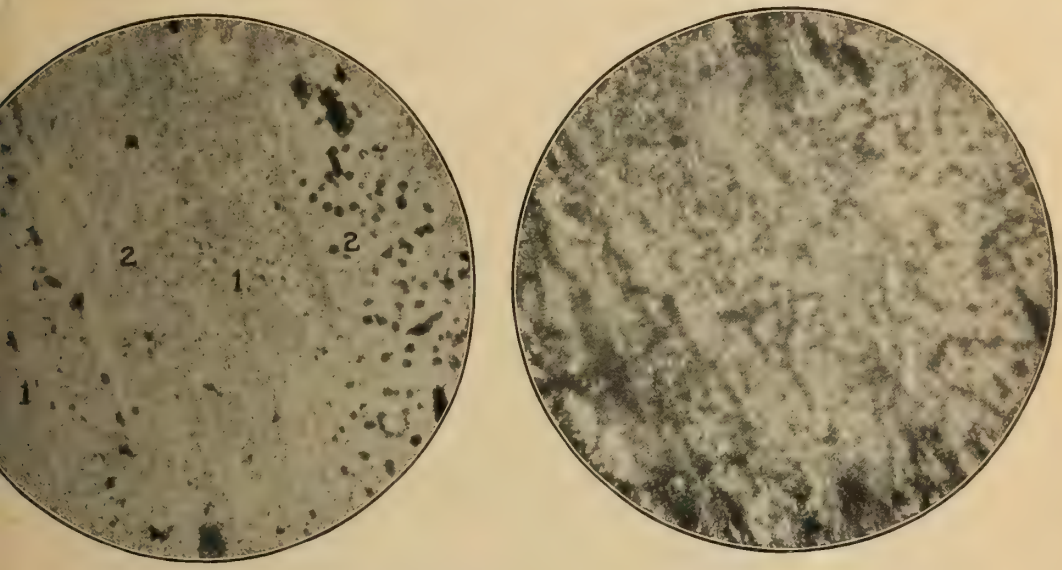


Fig. VI.

1. Green Chlorite. 2. Colourless chlorite. Nicols.

Shows banding of chlorite schist and occurrence of opaque dirty patches.

The carbonate is for the most part finely granular, some bands showing very coarse grain. The whole rock shows banded structure which is marked by small bands of fine opaque dust, or by difference in the size of the grains.

The structure indicates considerable movement since the formation of the carbonate. The occurrence of coarse-grained patches along one of the bands confirms this. At one part this shows intense crumpling and folding on a small scale with granulation of large crystals of carbonate.

Characteristic of No. 3 Vein—Constitutes from One-third to One-quarter of Vein Matter.

See Fig. VII.

A banded rock rich in quartz consisting of pure quartz bands and other bands containing sericite, some of which are very rich in pyrites.

It consists for the most part of granular quartz, the grains being of two sizes, coarse and fine grains. Strain-shadows in the larger grains indicate differential pressure subsequent to the formation of the veins. All the quartz is rich in liquid inclusions, which usually have a gas bubble inside them. Carbonate is distributed through the slice in considerable amount. The rock slice has a banded structure, the bands being marked by the development of tourmaline, pyrites,

carbonate and sericite, sometimes some of the compounds being absent. The tourmaline occurs in small needles, colourless or greenish-brown, with a distinct pleochroism.

The needles have parallel arrangement along the direction of the banding.

The pyrites occurs in small crystals and less often in large patches with irregular shapes, in the veins.

Sericite is found in certain of the bands being associated with tourmaline.

A very little green chlorite occurs in the veins and just outside them. There is also a certain amount of opaque indeterminable matter in the bands.

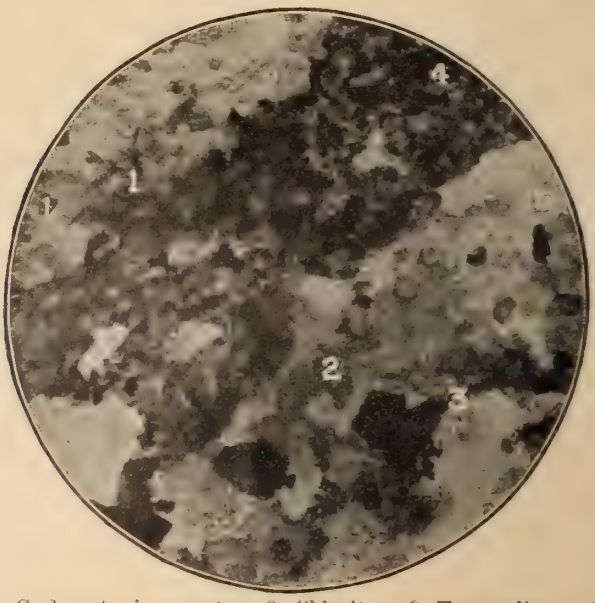


Fig. VII.—1. Carbonate in quartz. 2. Chlorite. 3. Tourmaline. 4. Tourmaline with pyrites. 5. Quartz with carbonate. Shows a tourmaline band rich in pyrites with large crystals along parallel band.

Surface No. 3—300 Feet East of Ward—(Deep Pit.)

See Fig. VIII.

A brown stained, honey-combed quartz gossan with a considerable amount of free gold showing.

The rock is an almost pure quartz of very coarse grain, but with small interstitial granules. The quartz is full of liquid-gas inclusions. Brown stains of iron oxide are common between adjacent grains. A little interstitial chalybite or iron-stained carbonate occurs and is often very dirty. Gold occurs in considerable quantity either in stringers in the quartz or in specks and stringers with dirty carbonate in the quartz. Only a very few crystals of pyrites occur with dirty carbonate. One such crystal has gold partly wrapped round it. One small patch of chlorite occurs. A few crystals of feldspar are scat-

tered through the rock. They are of a basic oligoclase (extension angle 16 degrees and optically negative) and show albite twinning.

The occurrence of feldspar suggests affinities to an aplite vein.

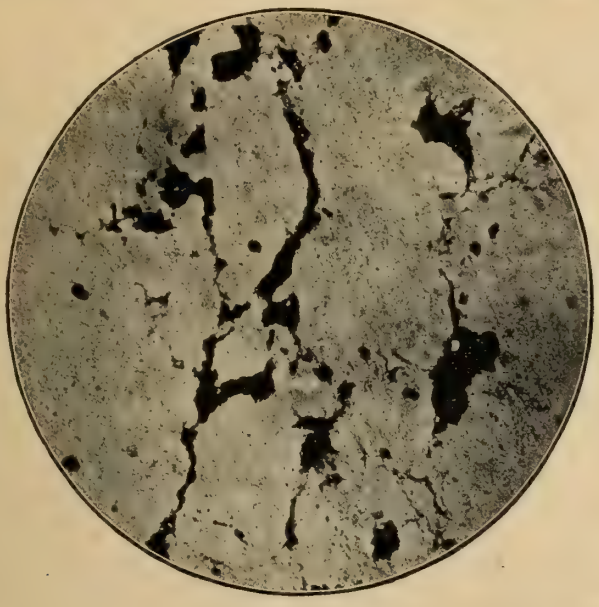


Fig. VIII.—Stringers of gold in coarsely crystalline quartz.

No. 3—Smoky Streak—on Footwall at Pit 200 Feet E.

See Fig. IX.

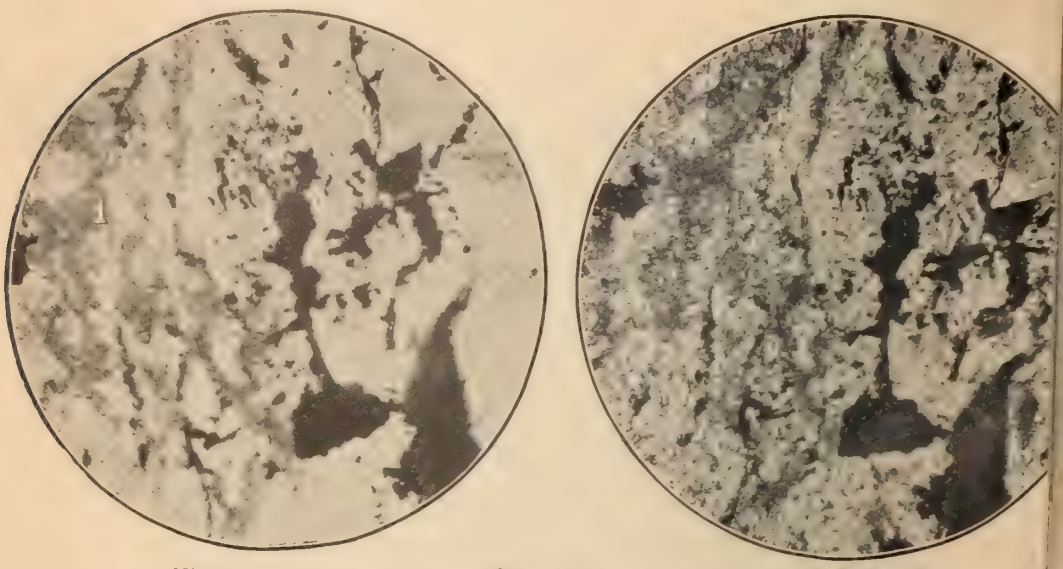
Banded quartz with dark bands rich in pyrites, showing free gold, chiefly in the clear quartz just outside the dark bands.

The rock consists of quartz and carbonate, the former predominating. The quartz occurs as coarse and fine grains, chiefly the latter. The large grains show strain shadows. Inclusions of liquid and gas are very numerous.

Veins of pyrites associated with tourmaline quartz and carbonate run through the rock. The tourmaline in parallel needles and the pyrites in good crystals, but chiefly in irregular bunches of crystals, are present in large amount. A little sericite is found along with tourmaline in some of the veins, but is not important in amount. Still less abundant is green chlorite.

Gold is associated with the pyrites in some of the veins and its relation to the pyrites is brought out by examination by reflected light. The gold occurs in stringers and small specks in the vein and in addition is found in contact with pyrites, or partly wrapped round the crystal. Most of the gold occurs in irregular bunches and only a few individuals show crystal shape. A little distance from the vein at one point small pyrites crystals and small gold particles occur along parallel cracks, their appearance suggesting contemporaneous deposition.

Opaque indeterminable matter occurs in some bands.



Nicols. Fig. IX. 1. Carbonate.

Pyrites and gold in quartz carbonate vein. Pyrites wrapped round by gold. Quartz finely granular.

No. 3 Centre of Vein—Deep Pit at Bottom—Green to be Identified.

See Fig. X.

A white quartz with green bunches and streaks rich in pyrites and with free gold showing at the edges of the patches and outside the edges of the veins.

A quartz rock with a fair amount of interstitial carbonate. The quartz grains are both coarse and fine, chiefly the former, and showing strain shadows and very many liquid inclusions with gas bubbles. The carbonate, in addition to forming a cement, in many parts of the rock is seen running in straight and narrow veins through quartz grains. A little sericite is found associated with the interstitial carbonate.

Pyrites, carbonate, and a few small tourmaline needles of a greenish-gray colour are developed together, occasionally with a very little sericite and chlorite. Tourmaline needles are seen penetrating two adjacent quartz grains.

A little gold occurs as ragged patches, stringers, and wires just outside the tourmaline bearing veins, a roughly parallel arrangement of gold and tourmaline bands being seen at one point.

No. 3—Centre.

See Fig. XI.

A white quartz with green bunches and streaks rich in pyrites and with free gold showing at the edges of the green patches, or just outside and closely associated with the streaks.

The rock is composed of quartz and a large amount of sericite, and some carbonate. The quartz is of both coarse and fine grain,

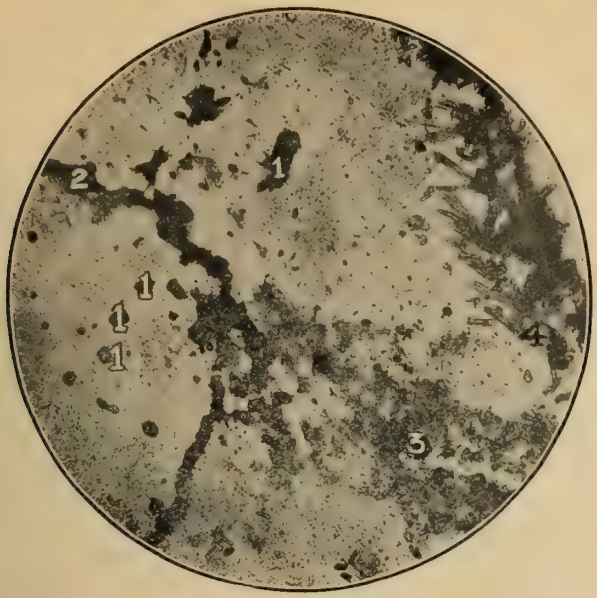


Fig. X.—1. Pyrites. 2. Gold Stringer. 3. Opaque calcite. 4. Tourmaline needles. Parallel band of Tourmaline needles and stringer of gold in quartz. Crystals of pyrites.

the former showing strain shadows, and liquid inclusions containing gas bubbles are found in both. The sericite is developed in bands which are very rich in pyrites. Tourmaline is found along with the sericite, but only in small amount. It has the usual development in small needles. Chlorite occurs in the sericite bands and the carbonate is found in the bands, too.

The pyrites is usually in large crystals and aggregates, sometimes in small crystals. It is very abundant. A little free gold is seen distributed in little specks through the veins, among the pyrites, and at one point it is seen wrapping round pyrites.

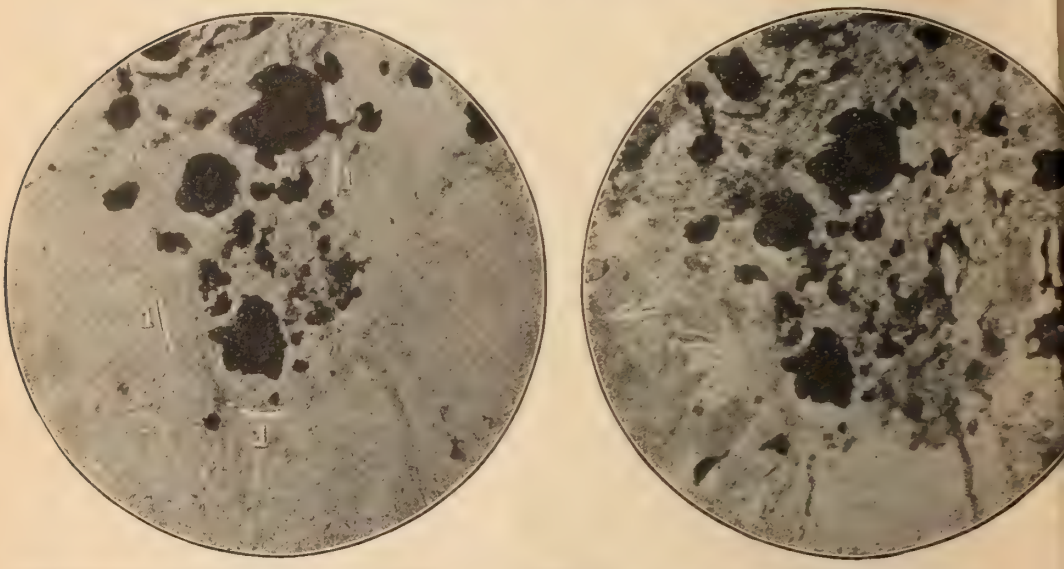
Conclusions.

The general relations of the quartz veins and carbonate veins point to the greater age of the latter. For the most part the quartz veins cut the carbonate veins, this being excellently shown by the microscope and only in rare cases there are small veinlets of carbonate cutting through several quartz grains and hence formed later than the quartz. The general distribution of the carbonate through the quartz rocks is to be accounted for, in part, by solvent action of the waters which caused the deposition of the quartz giving rise to contemporaneous formation of quartz and the carbonate found with it, and in part, to solvent action of percolating waters and deposition subsequent to the formation of the quartz.

The nature of the quartz, its granular character, and richness in liquid and gas inclusions, point to an igneous origin, or, at any rate, to deposition from hot solutions rich in gases. Conditions requisite for the formation of quartz with these characters are such as exist in the final stages of intrusive activity. The existence of feldspar in some of the slices shows a relation of the vein matter to aplite, and

the presence of tourmaline adds weight to the idea of an igneous origin of the vein matter.

The later stages of intrusion of a granitic magma are characterized by the injection of pegmatite and aplite veins, with a progressively increasing acidity. The final stage of such an increasing acidity would be quartz and the more volatile and more soluble constituents of the original magma would be concentrated in this residual quartz. The products of these final stages are quartz veins characterized by such volatile and more soluble constituents as well as those of a low melting point, which are immiscible with the general magma. Such constituents are gases, water, boron-rich and fluorine-rich minerals, tinstone, pyrites, gold, and so on. Of these constituents



1. Boundaries of sericite patch or tongue. Fig. XI. Nicols.

Shows very rich development of pyrites in sericite vein cutting quartz.

the gases, water, tourmaline, pyrites, and gold are widely distributed in these rocks from the Porcupine district, and afford evidence sufficient for the conclusion to be drawn that these rocks are connected with an intrusion, probably of a granitic character, without having direct field evidence of the same.

The problem of the relation of the gold to the pyrites and the time of deposition of the gold does not receive very clear solution from examination of rock slices. But such evidence as is obtainable points to the fact that the pyrites and gold were roughly contemporaneous in deposition and that the gold to some extent was deposited at a slightly later time than the pyrites round which it wraps itself. Some slices show specks of gold scattered through a vein rich in pyrites, of which the appearance is that of being formed wholly at one time.

Subsequent enrichment in the gossan and oxidation of pyrites leaving a quartz rock rich in gold is similar to that found in very many cases of mineral veins.

The character of the quartz indicates considerable movement in the district, or at any rate earth-pressure of some magnitude, giving rise to "strain-shadows" in the large grains of quartz and to fine granulation of the same along junction planes between adjacent grains. Granulation may affect whole bands in some instances. The same evidence of earth-stresses is afforded by the country-rock, the chloritic schists, and by the dolomitic vein filling, by its banded and granulated structure, some large crystals showing progressive stages of granulation. Folding, also, of bands of the dolomite indicate the same origin.

That there has been considerable movement in these rocks cannot be doubted, but the condition of the quartz indicates that some part of it took place subsequent to the formation and filling of the veins.

DISCUSSION

Of Paper by Dr. John Stansfield on "Microscopic Examination of Some Typical Specimens of Porcupine Rocks and Vein Matter."

C.M.J., Feb. 15, 1911, p. 109.

The descriptions of the rocks and ores from the Vipond mine, show these specimens to have characters in common with those from other parts of Tisdale Township. It is noteworthy that while the wall rocks of different deposits are of many different rock types, they have all been so altered by secondary processes to carbonates, that it is almost certain that they have been acted upon by solutions which emanated from the fissures later filled with gold-quartz. As Mr. Stansfield points out, the quartz veins are in most cases younger than the carbonates. The carbonates are, however, not all in the form of veins; but form replacement deposits in altered rocks, and the quartz veins are clearly younger than the carbonates which enclose them. The relation of the quartz to the carbonates is well illustrated on a large scale by the Foster lode, of which photographs have been shown in this journal. A similar relation for minute quartz veins is found on microscopic examination.

It is well to point out, however, that as Mr. Stansfield notes in some of his specimens, there are some carbonates in the quartz which are younger than the carbonates in the wall rock and younger than most of the quartz. The younger carbonate, moreover, is not the same as the older. In some specimens from the Dome mine it is apparently calcite, while the carbonate in the wall rock is ferrodolomite.

The character of the quartz at the Vipond is evidently like that of other deposits, largely made up of coarse grains full of inclusions and showing strain effects and in less degree of fine grains which have been produced partially by crushing, aided by solution and recrystallization. These finer grains are then younger than the coarse, as are also the small particles which were not so evidently formed from neighbouring quartz grains, and which may have been deposited from solutions coming from some distance.

The character of the veins and the abundance of carbonates strongly suggests that the solutions which altered the country rocks and deposited the gold-quartz were hot and contained constituents common in molten rock magmas. It is reasonable to suppose, therefore, that the solutions rose from an igneous magma which was intruded into Keewatin and Huronian rocks. The rock mass has not yet been located. It may underlie the deposits at considerable depth and nowhere reach the surface, or it may outcrop at some distance from the deposits.

Reginald E. Hore, Houghton, Feb. 25, 1911.

A Note on the Sampling of the Porcupine Ore Bodies,

Reprinted from the CANADIAN MINING JOURNAL.

By H. E. T. Haultain.*

Porcupine is the most important new mining district in Ontario to-day. We all want to know what the various bodies of quartz and schist will average when it comes to milling them. It is plainly evident that there is plenty of gold-bearing quartz up there, but it is not yet evident how much of it contains pay values, though we do know that some of it is bonanza ore. Upon the determination of the probable value of the quartz depends the making of some very heavy payments in the near future, and for the purpose of making reliable estimates much work is being done at large expense. Most of the work is systematic and elaborate, the very reverse of that which characterized the early years of Larder Lake. Not only is the surface being exposed by extended stripping and trenching, but shafts and drifts and cross-cuts to explore the bodies at depth are being systematically planned and executed. It is quite true that in some cases shafts have been commenced before sufficient surface work had been done, but it is equally true that some of the surface showings fully justified the expense of underground work without further delay. All this expense is for what purpose? To boom stock? I am glad to say that I do not think so, and to my mind, this is the best symptom in mining in Ontario to-day. This work is true exploration; it is for the purpose of examining the ore bodies and the first thing and the main thing in the examination of an ore body is the sampling, and Porcupine is going to give some trouble with its sampling. So much so is this going to be the case that some people will not be satisfied till they have elaborate "mill runs" or perhaps "smelter-tests." As a firm believer in the possibilities of sampling and also in the common "horse sense' 'of sampling, I submit a note or two in regard to the evident troubles. In the first place the quartz is going to be remarkably "spotty," not only spotty inch by inch, but spotty round by round. There are going to be hand specimens and "tie-pins" frequently associated with barren quartz as their immediate neighbour, and there are going to be fairly large blocks of barren or nearly barren quartz followed by equally large blocks of bonanza ore. The gold itself is all the way from fine flour gold to coarse and very coarse, though I saw very little of what might be termed "nuggetty" gold. Incidentally it is worth noting that the gold is certainly "where you find it" up there. It is in the quartz and in the schist, in the seams and in the solid, with the sulphides and in the white, so-called "bull

*Professor of Mining, Toronto University.

quartz." It is with the fine sulphides and with the coarse cube pyrites. It is with galena and with zinc blende. And also it can equally well be absent from each and all of these associations.

But to come back to the sampling. Can these ore bodies with their very erratic values be sampled? They certainly can be sampled in such a way that the results will be very far from a true guide no matter whether the samples are taken with a prospect pick or run through a mill, but I think they can also be sampled very satisfactorily by adapting general sampling methods to the special conditions, and I have no doubt that sooner or later transfers will be made on the basis of sampling and that careful managers will control their output and report their reserves based on sampling just as is done in all other respectable gold camps.

The values vary greatly from inch to inch across the veins—this calls for increased care in the taking of the individual samples, and despite this care it will result in greater variations from the probable mean value and consequently calls for more frequent samplings. The values vary greatly foot by foot along the vein. This calls for more frequent samplings. We must never forget that not only do we want to know the general average value, but we also need to study the vagaries of the ore body, wherever visible, that we may better interpret and estimate the unseen. That is the main difference called for —more frequent samplings, added to greater care in the sampling; greater care to more successfully eliminate partiality of motive and partiality of method, and more frequent samplings to permit of the greater chances of error "evening up." There is another aid to accuracy and that is to take larger samples. I don't mean to change our methods altogether and substitute the blasting down of samples of several tons weight for the sample carefully taken by hammer and moil. I mean that the sample should be increased in pounds, not tons, that where we took a 10-pound sample in copper ores, we should take a 50-pound sample in Porcupine. But the taking of the larger sample should never for one moment permit us to relax our care in the taking. It is hard to persuade the ordinary man that the erratic results of individual samples do not make all care seem foolishness. They say, If with all your care your results are each very different from the true average why are you so careful? Samples taken at haphazard will not vary to any greater extent. The answer is that other things being equal, chances will even up; with great care exercised in each sample to get the right proportions, etc., the errors will balance when many samples are taken. This is true philosophy, it is also horse-sense and everyday experience.

I think it might be very good policy occasionally to satisfy oneself by taking a large sample by blasting down several tons, breaking it up small with hammers and carefully quartering it down, remembering always to break the larger pieces before each quartering, so that we would wind up with, say, 25 pounds of material that would pass a 4-mesh, or, better still, an 8-mesh screen, and sending this 25 pounds to the assay office to be assayed.

Particularly in taking surface samples where the ore has not been shattered by blasting it would be well to jar up the surface by a row of holes 18 inches to 2 feet deep, followed by the taking of a fairly large sample, say one hundred pounds for each five feet of

sampling, but let there be no relaxing in the painstaking care of the sampling because of that 100 pounds instead of 10 pounds.

Frequent samples taken in this way will give a very reliable idea of the true values. A few samples, no matter how they are taken or of what size, cannot represent truly the erratic ore bodies on Porcupine.

Personally, I should have very much the greater preference for a system of sampling that "quartered down" every round of muck as it was brought to surface. The extra cost of doing this, that is, the cost above added to the cost of the underground workings, would be small in comparison and the results would be something to swear by. The bucket could discharge over a splitting board, one-half could go direct in a car to the dump, the other half could be broken up with hammers and cut down on sheet steel plates.

Porcupine ores will be new for many assayers. Their final sample should be much larger than usual, they must be keenly alert for metallics, they should crush their final sample through 150-mesh, certainly through 120. They should not work with less than one assay ton and should make their assays in duplicate and triplicate. They should also take duplicate samples of the sample brought to them to check their own methods of quartering and care of metallics. The bucking board must be a good one, free from holes, and the man who bucks the samples will need especial training and overseeing. There are more errors made in breaking down samples than in assaying.

Given proper care and these common-sense precautions, reliable results can be obtained and the only added value of the mill test will be psychological. But there is nothing that will obviate the necessity of skilful care if the results are to be reliable, and skilful care means the expenditure of money, much more money than one is accustomed to see spent on such apparently simple things as sampling and assaying. If the sampling and assaying are not done with elaborate care, costing money, the result will be a poor guide; it will be worse, it will misguide. Mill-tests and long-distance shipments of big samples cost money. My idea of the situation is that money spent on proper sampling and assaying will give very much more information in regard to the values of the ore bodies than the same money spent on mill-tests, but to attempt to sample and assay Porcupine ores in a casual way would be a travesty on scientific methods and on horse-sense.

SOME NOTES ON THE PHILOSOPHY OF SAMPLING.

By H. E. T. Haultain.*

A sample is a part to show the quality of the whole. Sampling is the obtaining of that part. In mining work we have the sampling of ore in place, and the sampling of broken ore. The sampling of an ore body, i.e., ore in place, is an art requiring knowledge, experience, skill, and the exercise of relentless care; the best method of procedure varies with the local conditions. The sampling of broken ore is largely a matter of procedure so simple as to be termed mechanical, or else is entirely the work of machinery. It is impossible to eliminate

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skill from the sampling of ore in place, if the result is to be reliable. The greater the experience and skill of the sampler the more reliable will be the result. On the other hand with the sampling of broken ore, the more that skill is eliminated, and the more mechanical and fool-proof the procedure, provided it is on correct lines, the more reliable will be the result. The reason for this is that the sampling of a body of ore in place is an imperfect method at its best, because only a small part of the ore can be seen and handled, whereas with broken ore the entire quantity can be passed through the process or apparatus. The result of sampling ore in place is an approximation and the skill and experience of the sampler is called into play, first in the obtaining of the samples, and, secondly, in interpreting the results. The sampling of a body of ore in place results in a series of samples, probably the average value of the ore, but which when taken together and properly interpreted will result in a reliable estimate. The sampling of a quantity of broken ore may result in one small sample which is so close and sure an approximation that it will represent the total quantity as accurately as our modern sensitive scales will weigh it. But this small sample will consist of a very large number of pieces or particles of ore, no one of which may represent the average value of the lot, some of which may be many thousands of times as rich as others, but when taken together (without further interpretation) will accurately represent the original quantity. (The series of samples which represent the body of ore in place may be considered as having a similarity to the particles of ore which go to make up the final sample of a quantity of broken ore.)

The Sampling of Broken Ore.

What is the first essential feature required in the result of the sampling of a quantity of broken ore? Surely the answer is accuracy, and the second feature, fully as important as the first, is that we should know that the result is accurate. There is little use in the result being accurate if we have our doubts about it.

To assure accuracy we must have impartiality of motive in the man and impartiality of method in the procedure. Many think that it is only necessary to have impartiality of motive and will consider a grab sample taken with eyes shut a fair sample. They will say that if you tear a sheet of paper into a score of scraps and throw these into the air over the pile of broken ore then pieces of ore taken where each scrap of paper fell will constitute a fair sample. This eliminates the partiality of motive, but the method is still partial in that it takes samples only from the surface, or perhaps from only a small area of the surface, of the pile. Others will tell you that a large sample is a fair sample and the only fair sample, that there is some special virtue in a two-ton sample sent through a "mill-test." With the value of the "mill-test" I have dealt in a previous article.* The value of the large sample depends on the way it is taken, just as does the small sample. There may be partiality of method which will completely upset the accuracy of the large sample, and it is generally much easier to protect the small sample from salting than the large sample.

*Canadian Mining Journal, Jan. 1st, 1909.

But impartiality of motive and impartiality of method alone are not sufficient to insure an accurate sample; one thing more is necessary. The sample must contain a sufficiently large number of separate particles. If we had 900 one-ounce pieces of quartz and 100 one-ounce pieces of galena mixed together we should have a mixture containing 10 per cent. galena. If the pieces were uniform in weight, then nine pieces of quartz and one piece of galena would be a representative sample of the lot. Fewer than ten one-ounce pieces could not possibly be a representative sample. Nor would there be much chance of getting one and only one piece of galena in a sample of ten pieces by any method of cutting down, no matter how impartial our motives and our methods might be. This extreme care emphasizes the fact that chance or probability plays a large part in sampling, but other things being equal chance evens up in the long run. We must not only have at least ten pieces in our final sample to permit of the mathematical possibility of its representing the 10 per cent. mixture, but we must have a very much larger number to even up the chances no matter how impartial our methods. How many pieces should constitute a minimum sample is not easy to define even by higher mathematics, but it is not difficult to err on the right side if we take the precaution to crush the samples before cutting. One pound of ore crushed to pass a 30-mesh screen will contain many millions of separate particles, and with all ordinary ores, if this is halved by any reasonably impartial method the chances will even up so completely that the most careful assay cannot detect a difference in the value of the two halves. But should the ore contain particles of gold so large that they will barely pass the 30-mesh we have an extreme case calling for special treatment. The assayer recognizes this, and where metallics are present screens them out and treats them separately. In a $20-ore one particle of gold in the sample will call for an equivalent of 30,000 particles of barren quartz, each weighing as much as the gold particle, or of more than 200,000 particles of similar size. For this reason the assayer should use a finer screen for gold ores than for other kinds and should watch most carefully for metallics.

In finely crushed gold ores the value of individual particles will vary from nothing up to $600,000 per ton. In coarse particles the values will not run so high, consequently it is not necessary to have so many particles in the large sample of coarsely-crushed ore as in the small sample of finely-crushed ore.

To sum up: Experience based on the work connected with the sale of many millions of tons of gold-bearing ores shows that a carload of ore may be truly represented by a small sample. Where no metallics are present three ounces of 120-mesh material may truly represent the carload of 50 tons.

To get this result impartiality of motive, impartiality of method and sufficiently fine crushing is all that is necessary. The process is generally a series of halvings of the ore, one-half being rejected and the other half again halved and so on. As the sample is reduced in quantity the individual particles are reduced in size by repeated crushings. In regard to the fineness of crushing, Richards gives this table:—

Size, Inches Cube or Mesh	Weight of Sample, Pounds.
2 inch	10,000
1 inch	2,000
1½ inch	400
¼ inch	200
⅛ inch	75
10 mesh	25
50 mesh	1

Where metallics are present the limiting size of the sample depends upon the coarseness of the metallic particles. In the extreme case of some of the Cobalt ores the metallics are removed before the first cut in the carload is made, and this may be necessary in some phenomenal nuggetty gold ores.

But with the majority of gold ores it is not necessary to attempt to separate the metallics until the sample is reduced to one pound in weight. The criterion is not mathematical deduction, but practical experiment.

Sampling Ore in Place.

In sampling a body of ore blocked out in a mine at best we have only access to certain "faces," the "sides" (more truly edges) of a block of ore exposed by shafts, tunnels, etc. We may be able to see four sides or edges of the block and our ordinary sampling methods with moil and hammer may then perhaps reach as much as 2 per cent. of the ore and the value of the 98 per cent. unseen must be based on the results obtained by sampling the 2 per cent. No rules will govern here. The peculiarities of the ore body must be interpreted by the judgment and experience of the man. In regard to the sampling of the exposed faces, however, the underlying philosophy is similar to that of sampling broken ore. Theoretically the surest way would be to take a slice of uniform thickness from all the exposed face and pass it through the procedure for sampling broken ore. This would give us an entirely true result as far as the average value of the whole face was concerned, but if the face were of varying width and varying value it would still leave us ignorant concerning these variations of value and it is largely on the proper interpretation of these variations that we base our estimate of the unseen ore. If we cut up our slice along the exposed face into sections and sample each section separately, we get information concerning the variations and the shorter the length of each section, within reasonable limits, the more complete our information. Sometimes this can be done, for example, by sampling each round of muck as it comes from shaft or tunnel, otherwise it very seldom is practicable. As a substitute the next best course is to take out small short sections at intervals, and in practice this comes down to cutting a "channel" with hammer and moil. In this we get very far away from the simple, fool-proof procedure of sampling broken ore. The dangers resulting from partiality of motive and partiality of method are seriously magnified. There can be and often is wholly unconscious partiality of motive. A mine foreman knowing his ore intimately and deeply interested in his mine can rarely take impartial samples. Impartiality of method is assailed by the varying degrees of hardness or brittleness of the ore, and less

consciously but perhaps more dangerously by sudden variations in apparent value. This sampling of ore faces by hammer and moil (which is certainly the best method as well as the standard method) calls for experience, sound judgment, skill, care, patience, persistence, more than any other operation that falls to the lot of the engineer. Given all these, given complete impartiality of motive and of method, our final result must be gauged by the weight of the chance. Just as a few particles cannot safely make a representative sample of a lot of broken ore, so a very few sections of an ore face cannot safely represent the whole ore face. I think we can sanely say that one sample taken across a small section of an ore face by itself means nothing. It is only in association with others that it has its value. One sample may be very far from the average value, each sample is probably more or less so, but in many samples the "chances even up" and our average value, more surely correct the more frequent the sampling. This, then, is the mechanical side of the question, as it was with sampling broken ore. There must be many samples of a face, as there must be many particles in the sample of broken ore. But in sampling broken ore we erred easily on the safe side by sufficient crushing. In sampling ore in place we can never get too many samplings. On the same line of reasoning our individual samplings should not be too small. With very evenly valued, disseminated ore small samples may be all right, but the more the ore is spotty the larger should be the sample and also the more frequent.

Increasing the size of the sample is only to be used as an added guard. Many seem to think that the large sample in itself carries the evidence of impartiality.

It is probably the reverse. The large sample may suffer from partiality of method through an excess of the more easily broken part of the ore, or from partiality of motive from being taken by blasting from a richer (or poorer) part of the ore body. There may easily be specimen carloads as well as hand specimens. Frequency of sampling is of much greater importance than increase in the size of the sample.

In conclusion, there is no royal road to the sampling of ore in place, as there is no mechanical road. Impartiality of motive and of method are the first essentials, but to these must be added all the human attributes included in experience, skill and care, and to all this must be added frequency of sampling to appease the Goddess of Chance. The one exception to this, the only approach to the mechanical and the fool-proof, is to sample by suitable halving methods all the muck as it comes from each round blasted in shaft or tunnel or cross-cut.

Reporting on Prospects.

(Written for the CANADIAN MINING JOURNAL by W. E. Segsworth.)*

In writing this article I merely desire to set down a few ideas that have crystallized during the course of time, in the hope that they may be useful to others. I wish to disarm criticism by saying that many things which I have said might have been said better by others, or may be disagreed with. I may also have left unsaid many things that may seem to be of more importance to others than what has been said here. If, however, the article results in helpful discussion it will have served one of its purposes.

The examination of a prospect calls for cool judgment, close observation, wide experience, and the ability to weigh against each other many conflicting considerations. In addition to this the engineer must have the power of detaching himself from his own personal prejudices.

Undoubtedly the main facts to be ascertained are·

First, Is any ore exposed on any of the boundaries of the property?

Second, What is the average value and width of the ore exposed?

Third, Can the determined grade and width of ore be worked at a profit under the surrounding conditions?

Fourth, What are the prospects for the continuance of the ore, or for its increase or decrease in value?

To obtain answers to these questions, it is advisable to keep in mind the lines of inquiry that may be followed with profit. It will, of course, be understood that in any one prospect probably not one-half of these lines of inquiry are of immediate importance. Those that are of no importance can be quickly eliminated and attention concentrated upon those remaining. I give below a list of the important points.

Prospects of Ore (Economic Geology):

(a) Is there any ore exposed on any of the bounding planes of the property? If so, what is its length, breadth, and value?

(b) Is the formation favourable to the kind of deposit examined?

(c) Is the formation in which the deposit occurs likely to continue in depth; or to change? If so, what effect will it have on the deposit?

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(d) Is the deposit much faulted? If so, what effect will it have on the prospects of holding the ore, or the cost of working?

(e) What type of deposit is the one examined? What conclusions may be drawn as to its probable size, continuity, and value?

(f) Are there any evidences of secondary enrichment?

(g) Does the deposit show the effect of surface weathering? If so, to what depth?

(h) Effect of eruptives?

(i) Blind veins?

(j) Evidence to be gathered from surrounding properties?

Metallurgy:

(k) Can ore of the probable extent and value indicated by the exposures be treated at a profit under the existing conditions?

(l) If the ore is to be smelted can a suitable smelting mixture be made with the materials to be had, within an economically possible freight rate?

(m) What influence will the process of treatment have on costs?

Costs of Operation:

(n) Transportation.
(o) Labour.
(p) Supplies.
(q) Development, cost per ton.
(r) Stoping, cost per ton.
(s) Cost of fuel.
(t) Water, cost of pumping.
(u) Cost of equipment.
(v) Cost of treatment.
(w) Interest and depreciation.
(x) Royalties and taxes.

Market:

(1) Quotation price.
(2) Smelter rate.
(3) Cost of transporting ore to smelter.
(4) Cost of transporting metals to market.
(5) Brokerage charges.
(6) Is the market free or restricted?
(7) Competition.
(8) Influence of increased production on prices
(9) General market outlook.

Title:

Influence of the mining laws of the country on the industry.

Validity of title.

At the risk of being tedious, I have tabulated these points, and will discuss them briefly later. This list might be lengthened indefinitely. Indeed I have seen printed lists of questions in book form for the use of the examining engineer which contained questions in regard to every conceivable matter in connection with a mine or prospect; but it seems to me that the use of such printed forms must lead to reports as stereotyped in form and conclusion as the form on which the data are recorded. For this reason the above list is only given as

a guide and should be filled out, altered, or amplified to fill individual requirements and ideas.

Prospects of Ore—In considering (a), it should be kept in view that where there are no extralateral rights the property considered as a whole has the form of a prism of infinite depth, whose top is the exposed surface and whose sides are three or more planes (usually four) being common boundaries of the adjoining properties as in fig. No. 1. On the adjoining property to the south a shoot of ore has been opened on a vein striking north. This shoot pitches to the north

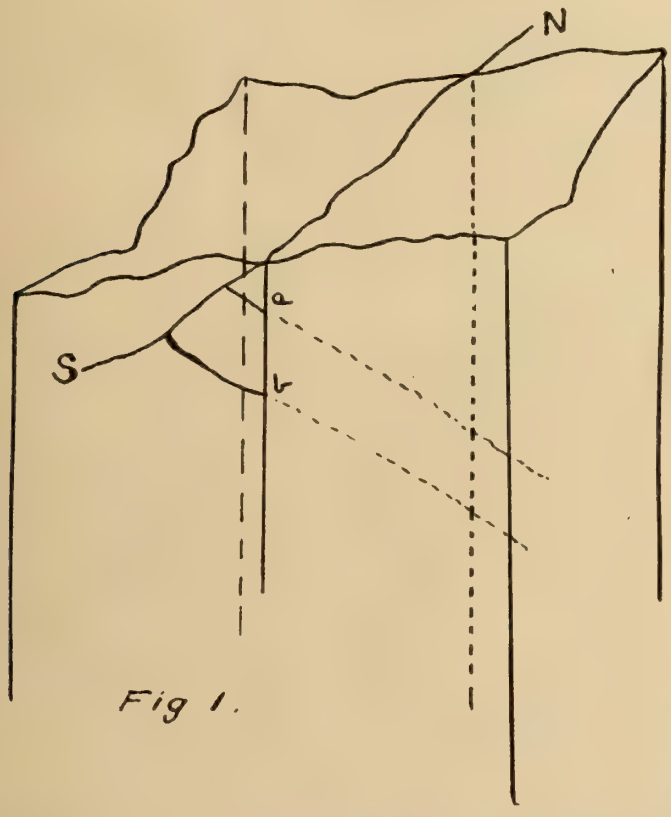


Fig 1.

and enters the prospect by the south bounding plane at depth. The ore has been mined up to the line of the prospect and has exposed a surface of the vein from (a) to (b) for sampling. It must be evident that such a surface, if it be accessible for sampling, is just as valuable a prospect of ore, other things being equal, as a like exposure on the surface. All exposures of ore should be sampled, measured and assayed just as carefully as would be done in examining a mine. There is no more reason for trusting to one's judgment for the value of ore exposed in a prospect than in a mine. Yet this is often done. Before sampling a surface exposure it should be well cleaned of all surface dirt, and a wide deep groove cut in the solid ore. This groove should then be thoroughly cleaned out before taking a sample cut from the bottom. If the sample is cut from the

natural surface it is liable to be too high on account of the concentration of valuable minerals in the small surface cracks or irregularities, or it may be too low on account of leaching out of part of the less valuable minerals from the immediate surface. One of the most common mistakes is to measure the outcrop on its horizontal width without taking account of the dip, and to assume that this is the true width of the vein.

(b) The preference which certain minerals have for certain formations is so well known that it needs no discussion.

(c) If a fissure cuts two formations and contains ore in one of them, it is quite likely to increase or decrease either in size or contained values on passing into the other. If the prospect is in a well developed district whose history in this respect is known, one may be able to foretell the change. If in a new district too much confidence must not be placed in comparisons with districts whose economic geology has already been worked out.

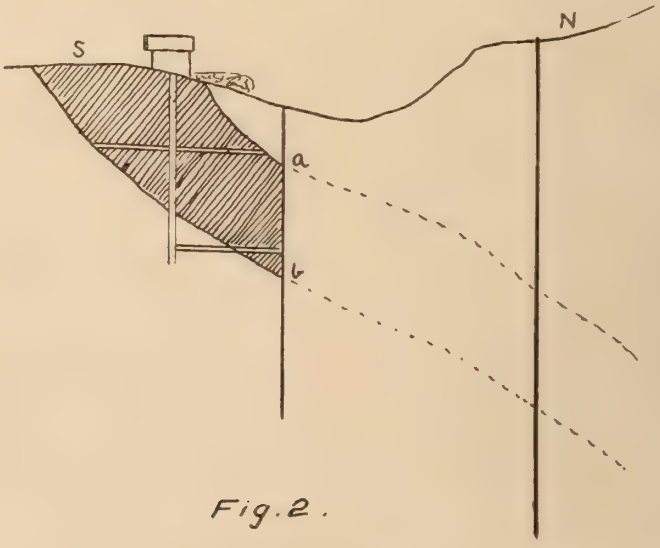


Fig. 2.

(d) In fig. 3, a section of a vein perpendicular to its strike is shown. It will be seen that the vein is faulted by a series of overthrust faults in a rather regular manner. However, as depth was attained, the fault planes were found to be closer together. After each section of the vein was worked out it was necessary to drive to the next section of ore, and, of course, the dead work was charged to the development cost of the block so opened up. The first block paid handsomely, the second a little less, but it was found that no profit was derived from the fourth, although the vein was equally wide and of the same grade as in the former sections. This is but one instance of the way faulting may use up the profits of working an otherwise profitable ore shoot.

(e) The considerations suggested by question (e) could not be profitably discussed here, as they involve the theory of the genesis of ore deposits—a field too extensive to be even touched upon.

(f) The theory of secondary enrichment should also be studied elsewhere. Its importance lies in the fact that where it occurs we have one of the few cases in which we may hope for enrichment in depth. If the sulphides are in their unaltered form on the surface there is no reason to expect enrichment in depth except in rare instances.

(g) Surface weathering without secondary enrichment points to the surface enrichment of the vein and a decrease of values in depth. This is due to the leaching out of some of the baser constituents of the ore, leaving the part remaining in a more concentrated form. It also sets free the gold and silver, leaving them in a state in which they may be more readily amalgamated and, if they are to be smelted, they are ready for smelting without roasting. However, it should be kept in mind that when we pass from the zone of surface weathering to the zone of primary sulphides, a change in treatment must be made. Sur-

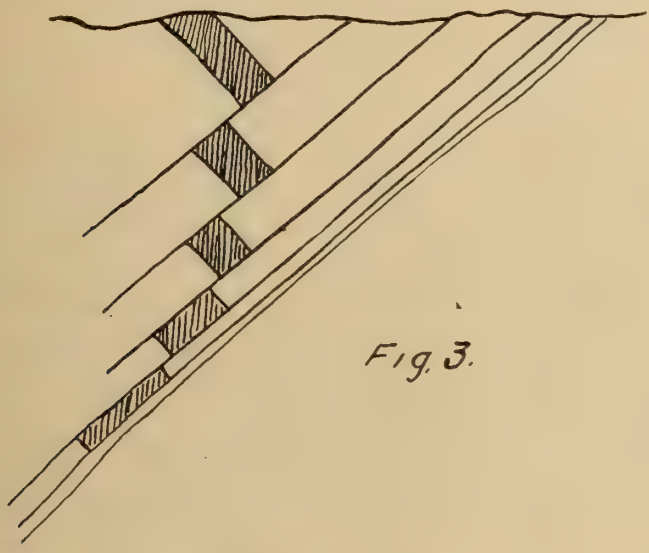


Fig. 3.

face enrichment may not always be an advantage as it may necessitate two distinct plants for the treatment of the ore, and the interest and depreciation on the first may offset the advantage gained by the richer ore.

(h) The effect of eruptives should be thoroughly studied.

(i) If the prospect is in a district already developed something may be learned on this point. If not, any prophecies are as dangerous as prophesying ore at depth in a fissure devoid of mineral at the surface under the same conditions.

(j) If a prospect is situated in a camp that has a number of operating mines, many of the questions discussed under "prospects of ore" may be studied under the best conditions and much information gained on the economic geology of the district. In most cases the market conditions, cost of operation, and metallurgical treatment may be determined with great accuracy. In cases where the adjoining properties have each worked up to their end lines nearly every factor

of risk may be eliminated. In many mines in the Lake Superior copper region adjoining properties have so far determined conditions on a prospect that the management was justified in designing and installing extensive plant and machinery before the ground was opened. These cases are rare, however, and evidence from surrounding properties should only be accepted with great care and applied with judgment. In the hands of the inexperienced such evidence is highly dangerous. It is not seldom part of the stock-in-trade of the fakir.

Metallurgy.

(k) A quartz ore containing a friable copper mineral may be so situated that it cannot be smelted owing to the impossibility of obtaining a base at a sufficiently low cost. It cannot be concentrated without too great a loss and cannot be cyanided owing to the consumption of cyanide overbalancing the value of the gold or silver recovered. Again, the ore may be an intimate mixture of two metallic minerals having physical and chemical characteristics so similar that they cannot be separated economically. Of course, this discussion is based on the state of the art at the time the examination is made. Later improvements may make ores valuable that are to-day useless.

(l) If an ore is to be smelted at or near the mine the question of flux and fuel should receive the most careful consideration.

(m) In any case some limiting figures should be placed on the cost of mining and treatment. If this cannot be done, a report will be of little practical value. The final method of treatment cannot be determined, however, until the prospect has developed into a mine.

Cost of Operation.—This subject has been so exhaustively treated by Mr. Finlay in his admirable book that the different items need no discussion. If the prospect is surrounded by working mines and has the same character and grade of deposit as the surrounding mines, the cost may be taken from them. If the prospect is in a new district one should make as close an estimate as possible of the cost of working the ore, putting limiting values on each item as closely as may be determined, basing the estimate on the supposition that the ore will extend to a reasonable depth and have the same width and value. From this one may possibly arrive at the conclusion that the property is not workable at the time and under present conditions. Estimates made in this way are infinitely more valuable than mere guesses, and at least serve as a guide to the judgment.

Market.

1. The price of gold is, of course, always fixed The quotation prices of copper, lead, and zinc, are usually given very closely by the technical journals since these metals enjoy an open market. All the other metals, together with the non-metallic minerals, have their prices fixed by private contract or mutual agreement and the prices quoted for them in the technical journals serve only as a guide. Before accepting a price on any of these minerals the market should be most carefully investigated.

2. Smelter rates should be obtained from as many smelters as possible. It should not be overlooked that distance is not always of first importance in determining smelter rates, but that desirable fluxing qualities may overrule the long haul.

3. Freight rates may, of course, be ascertained from the published schedules of the railroad companies, but should not always be accepted as the best rate obtainable. By negotiations the rate may at times be lowered considerably. The new rate is then published and becomes the public rate.

4. The producer of a metal must always pay for transportation to the open market even if the metal is never actually taken there for sale.

5. A great deal of ore and many mineral products are sold through brokers and selling agencies. In the case of those minerals which are sold in a restricted market the brokerage may amount to a considerable sum. This fact should not be overlooked in estimating costs.

6. As stated under (1) minerals that are sold under private contract or in a restricted market should be the subject of a most searching investigation. If the engineer is not already familiar with and in close touch with the market, he should either get the time for an investigation, or frankly state in his report that he is not prepared to report on the state of the market. Many otherwise good prospects fail because when the producing stage is reached it is found that there is no market for the product or that the actual price is much below the quoted price. Another common mistake is to estimate each metal at its full value while, as a matter of fact, the smelter may pay for only one or two of the metals contained in the ore. Indeed, I have seen all the metals in an ore estimated at their full value in a report, and when the ore was sold a penalty had to be paid on some of these metals.

7 and 8. Competition and the influence of new productions on price are closely associated. With the more common metals and those which are produced in large quantities, the addition of a new producer is not likely to affect the price much, but the effect of new sources of production on the price of a metal which is produced and used only in small quantities is likely to be disastrous unless the production is kept within due bounds, or unless some new use can be found for the metal.

9. Mr. Hoover in his book on the "Principles of Mining," treats of what he has called the base price of metals and discusses the fluctuations of metal prices. This chapter should be read.

Title.

When examining a prospect in a foreign country or in one where mining has not long been carried on, the engineer should make a careful study of the mining laws. The laws as regards royalties, taxes, and customs duties should be ascertained. In some countries, especially in the Latin Americas, there are many charges against the operation of properties that do not come under any of these heads, but that nevertheless must be paid.

The validity of title will, of course, be examined closely by a local attorney, but it is always well for the engineer to examine the title himself.

General Considerations.

The amount of capital to be used in developing a prospect is of first importance. There is a minimum amount necessary. What this is, one can only estimate, but limiting values can usually be placed upon the amount. If the purchasers are not prepared to find this

amount the property will probably be a failure no matter how good a prospect it may be.

When a prospect is discovered in a new district and under new geological conditions, too much is often made of comparisons with older districts. Suppose that a mineral has been mined in four properties, A. B. C. and D. in four different parts of the world, and that the geological conditions at A, B, and C. are similar, but quite different at D. Now, if all the properties have been operating for some time. everyone accepts the difference in conditions between the first three properties and the fourth without comment. But suppose A, B, and C have been operated under similar conditions for years and let D be discovered under different conditions; then the impression may immediately arise that it cannot be of any value. This is a very common fallacy. But, while comparisons with older districts are of the greatest value as guides, an occurrence under new conditions should never be condemned on comparisons only.

In any one prospect a great many of the points touched upon will be found to be of little or no importance. However, each must be gone over and those of no importance may be quickly eliminated from the enquiry and the attention concentrated on those remaining. I would suggest that numerous sketches and careful notes of all the above points be made in the field note book. All this information need not go into the report, but may become invaluable at some future time. Often after the report is made the engineer may be employed to direct the work, and copious notes and sketches may enable him to initiate operations without a second trip to the property.

It must be left to the common sense and judgment of the engineer as to what material should go into a report. but one should always remember that a report will be read by two classes of people. the layman and the engineer. The first desires a short and lucid statement of the main facts with a clear cut statement of the conclusion arrived at. The engineer, in addition to this wishes to have the details before him so that he may decide for himself whether the conclusions are justified in the premises.

To fulfil the needs of each class to whom the report will be presented, it is usually best to divide the report into two parts. first the general report and conclusion, and second an appendix containing the details, consisting of measurements. lists of assays. detail description of geology and outcrops, estimates of costs. freight rates. markets, etc., or such of these matters as are of importance. The report should as a rule contain a map of the property. showing the outcrop, assays, and geology. If the geology or development of the surrounding properties has had any bearing on the conclusions arrived at, a map showing these features should be included. if necessary. to a proper understanding of the facts.

A few engineers try to protect themselves by leaving out the details, so preventing any criticism of the conclusions: but if the prospect is developed and fails to fulfil its promise, their lack of nerve receives its reward, for then they are denied the opportunity to present the details which they should have set out in the original report.

When examining a prospect in a district unfamiliar to the engineer. he should always obtain local advice if it can be had. Do not be too ready to condemn what is new to you in mining practice. when it has stood the test of time. Although it may appear to be wasteful,

careful study may show you that it is the survival of the fittest under the ruling conditions. By obtaining local advice you may get a satisfactory explanation of what seems bad practice and save yourself from the mistake of promising economies which you cannot fulfil later.

In these days of changing conditions too much seems to be made of codes of professional ethics. If one has a sound conscience he will have no need of a conventional code of ethics. If he has not this conscience, there is no code of ethics he will not break. The one rule that should always be followed is to disclose in your report and to your principals your true position in relation to a property. Anything that cannot be set out there should not be done.

In conclusion, I would suggest that one should not be in a hurry when examining a property even if it be a prospect. Spend some time on a property (if it warrants it) and by turning the facts over in your mind with their bearing on each other, gradually arrive at a cool, deliberate judgment by a more or less unconscious integration of all the facts obtainable, remembering that one's judgment of a prospect can not always be correct and that your client is paying you to commit yourself definitely one way or the other. He should not, and likely will not, be satisfied with a report that does not commit the engineer.

The Porcupine Gold Area.

By W. E. H. Carter.*

Several articles have already appeared in the Canadian Mining Journal on this new mining camp, which give some information of the geology of the area and the veins, the topography and general character of the surface, and also of the routes by which access is gained, so that there is little left to note in these connections.

In hilly, rocky countries the casual traveller or prospector might easily form some correct conclusions for himself, but not so here where the surface of the land is flat and for the most part covered with clay and sand with a top dressing of wet swamp and dense spruce forest. The rock exposures throughout are widely scattered and then usually only low ridges of quite limited area well covered with moss and timber.

When the first general survey of this country was made by the writer for the Provincial Bureau of Mines in 1898, exploration was confined to the rivers and lakes and the country for a mile or so back therefrom on either side, from the height of land at Night Hawk Lake and Porcupine Lake to tide-water at James Bay and, although all these creeks and lakes that are now the scene of mining activity were then surveyed and mapped, so few rocks were observed (all apparently of Huronian Age) that the whole area from this point north for a good many miles, was considered as belonging to that geological period. With the present more detailed examination by prospecting, it appears that while there are large areas of Huronian in the shape of dark greywacke schist, the Keewatin green schists are also well represented. These two appear the most frequently and contain the present important veins. Other reported rocks consist of quartzites, some basic eruptives and conglomerate.

The veins are lenticular in character and irregular in width. In one case the quartz covers an area of approximately 100 feet by 100 feet, with some country rock intermixed, but this is exceptionally large. Most of them range from 5 to 10 feet, with occasional still

*Mining Engineer, 85 Front St. East, Toronto.

greater expansions. The few that have been stripped for any length maintain, generally, a uniform strike for that distance, over 500 feet in one case and 300 feet in many others. There does not appear to be any one favoured direction nor do they necessarily run with the formation.

Crossing Bar at Mouth of Frederickhouse River.

Shuniah Hotel, Pottsville.

The veins are of solid white and, in a few cases, blue quartz and are ideally free milling. The quartz itself contains only a very small proportion of metallic sulphides, probably under 1 per cent., and that mainly iron pyrites, but also specks of galena, blende and chalcopyrite. It is tough to drill, but crushes readily. The walls close to

the vein and also the inclusions of the same country rock in the quartz between the walls are on the other hand very highly mineralized with iron pyrites in crystal form, and as much of this will have to be milled with the quartz, the percentage of sulphides will be thereby somewhat increased. No weathering or oxidation has taken

Crossing Frederickhouse Lake.

Vein on Dome.

place beyond a few inches to a foot below the surface in the veins.

The first important discovery of gold is said to have been made in the southern portion of the township of Tisdale on the Wilson-Edwards claims, or, as they are now called, the Dome Mines. This was quickly followed by others in the same neighbourhood. The time was about the middle of last summer, and the rush of prospectors

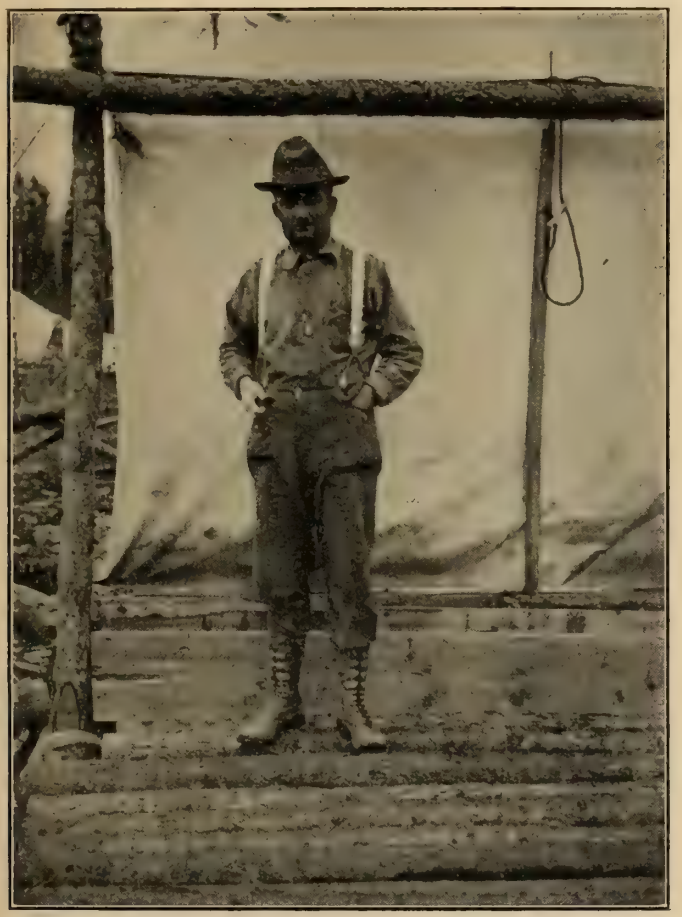
which followed has resulted since in the complete staking of the country for a number of miles in every direction. These same pioneers are now migrating still farther west beyond the Mattagami River, which lies a short distance to the west of Tisdale Township. Naturally, considering the distance from source of supplies and the long

Vein on One of the Dome Claims.

Typical Outcrop on low wet ground.

winter, but little development work has been as yet accomplished on any of the claims, and not until the end of the summer or later, with active stripping and other mining operations, will it be possible to form an idea of the extent of the pay ore area in the countless claims outlying the best finds of to-day.

The most striking feature of the field is the great number of quartz veins being found. Almost every day during the spring months new ones were uncovered, not only on hitherto untouched claims, but on those under active development, where already many had been laid bare. One wonders where it will end. Ordinarily such a condition of affairs causes fear that the gold will be found too widely distributed in small quantities and, consequently, insufficiently concentrated in any one vein or group of veins to produce pay ore.

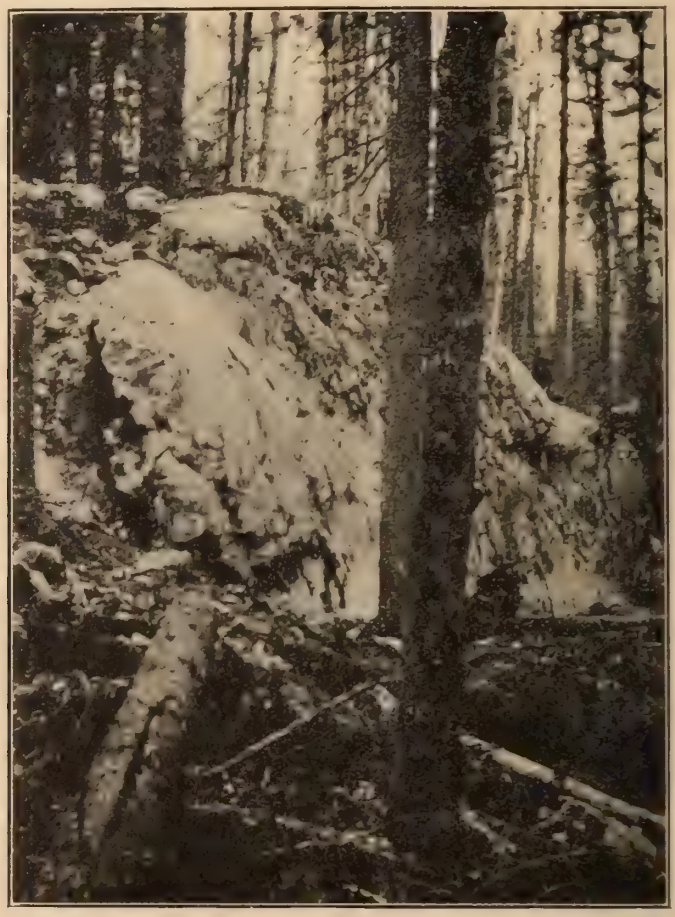


Wilson, Discoverer of the Dome.

Such has been the history of more than one gold-bearing field in Ontario.

However, this time there appears little doubt that the exception has been found. There is a group of claims near the southwest corner of Tisdale Township which probably holds the record in the camp for number of veins at short distances apart, and in every one of them gold can readily be seen in many places. Knowing the gold areas of Ontario so well, where it has been typical to find large scattered nuggets of gold, and then through the remainder of the vein practi-

cally nothing it was of particular interest to be unable to find, here or anywhere in the camp, such specimens. On the contrary the gold is finely disseminated, even in the richest samples. This is the most encouraging feature of the veins, for it indicates the likelihood of a better distribution of values throughout the quartz in those places where none can be seen.



Another View of Outcrop on Timmins' Claims.

Doubtless there will be pay shoots and barren portions in the best of the veins. This remains to be determined in the course of development by systematic sampling and assaying, little of which has as yet been undertaken.

On this particular group of claims a shaft was being sunk, then 60 feet deep, across the whole width of about 15 feet of the vein. Judging from the dump rock therefrom the quartz is remarkably rich, possibly $200 per ton for the whole dump. Say, however, that it only averages $100 per ton, the three hundred tons or so now in the pile

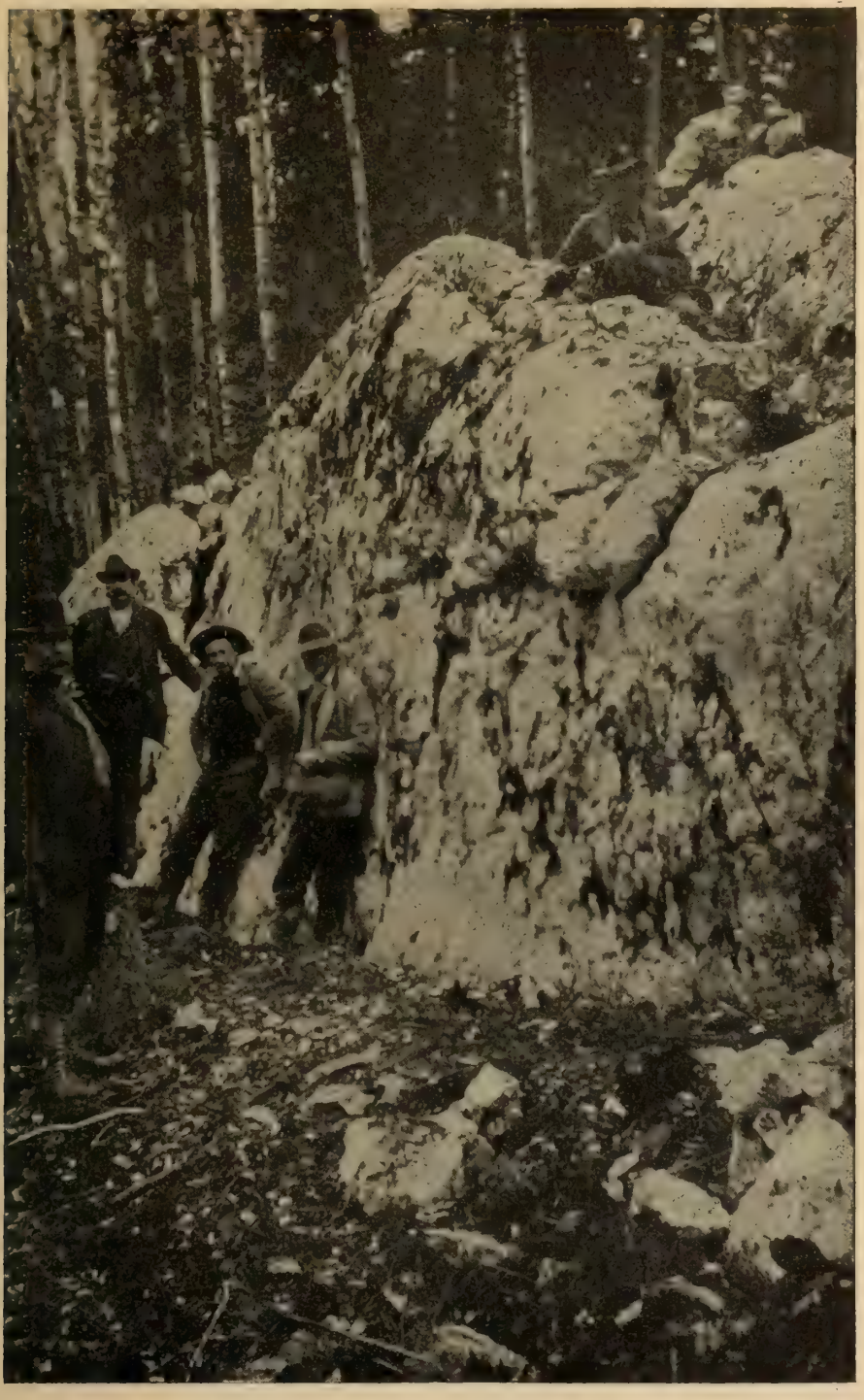
represent $30,000. If this can be repeated for even a short distance of vein at the same depth the values mount up into extraordinary figures. Adding to this the fact that there are, with almost no exploratory work done, a dozen or more quartz outcroppings on various other parts of the property, some of which have equally good surface showings, one may arrive at some conception of the possibilities. The veins were never less than 2 or 3 feet wide, and from that up to 15 and 20 feet, roughly averaging, as then uncovered, probably 6 to 8 feet wide.

Trenching in Swampy Country. (Foley-O'Brien lease).

Without as yet actually knowing the gold content of these several veins it is not likely that as mined they will average any such figure as that of the ore from the above mentioned shaft. But with such apparent quantity a much less average value per ton will suffice to make of them a most profitable mine.

There are several other properties, usually in each case a group of claims on which it has not been so easy to strip the surface and,

Vein on Porcupine Gold Mining Company's property. (Flynns' Option).



An Outcrop on Timmins' Claims (Hollinger).

therefore, less is known about them as yet. Much the same conditions prevail on all of these, however, as regards number of veins, but as to the quantity of gold they contain not so much is as yet known.

From what was seen it is not too much to expect that the area

Timmins' Shaft. Outcrop on extreme left looks like Dump.

will produce several paying gold properties, one of which, at least, will be remarkable for the amount of gold taken out.

The best showings to date are confined to the southern half of the Township of Tisdale with an extension into the northeast quarter. There were reports of finds of gold in the outlying areas, but no work of account had been done on them.

These better properties have not been acquired by the present owners, or optionees, for a song. Far from it. Prices paid were

abnormally high. In almost any other field they would be considered not only prohibitive, but absurd. Most of the claims with showings of auriferous quartz not yet sold are held at such high prices (considering that practically nothing in the way of prospecting and development has been done on them) that investors have held back and will no doubt continue to do so until they can see a chance for their money.

In justification of the high price the prospector or other owner asks a comparatively small sum down with time to work, but the latter is generally insufficient. It is difficult to get in supplies and men and requires more time and money for this rush development than in more accessible regions.

The high prices paid in the silver camps to the south have without doubt upset all idea of reasonable values and terms. As a result the public have stood away to a serious extent. This fact the claim owners have not as yet realized. They may too late. It is better to make sure of a reasonable sum, particularly when the buyer is expected to make all the discoveries and assume all the chances, than to hold out for a fortune and lose all.

*The difficulty of access to it has kept many possible investors from visiting the camp, and for the same reason the public has not yet realized its importance. On the whole this is not a bad condition. The trip to-day is very hard for one not accustomed to the bush, as he must walk more than twenty miles, half of which is through swampy country on a winter road. If the rumoured line of transportation in from Bisco on the C.P.R. via the Mattagami River materializes as outlined, one will be able to reach the camp by steamers and over portages by automobile. It would be well worth the trip to enjoy the scenery along this route.

*The present route is from Kelso on the T. & N. O. Railway, past Frederickhouse Lake and Night Hawk Lake, about twenty miles of walking and fifteen by gasoline launch. The trip is made in a day, with arrangements for the passenger already well organized. Not so, however, for freight, which it is very difficult to get in at all, and then at a cost of $6.00 per hundred from steel to Porcupine. Some improvement in this may, however, be expected as the summer progresses.

Towards the end of May there were about 500 men at work for the larger outfits. In addition, probably half that number were scattered throughout the area doing assessment work. Prospectors were arriving in considerable numbers every day, the majority travelling to newer fields in the neighbourhood of the Mattagami River and west.

Higher wages are paid here than in the more settled camps to the south. Miners receive $2.75 to $3 per day, with 25 cents per day added for shaft work; helpers about 25 cents less, and surface men $2.50, all clear. The demand was greater than the supply at the time of my visit, particularly for foreign labour which is the most suitable for trenching operations.

A kind of telephone line has been strung on trees from Matheson in to Porcupine, and continues to a few of the mines. Occasionally it gets out of order, but messages may be sent right through with a fair certainty of their arriving without much delay.

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*Editor's Note.—Conditions have entirely changed now, of course. Telephone and railway communication are now installed. An excellent mail service will soon be established.

Porcupine Gold Deposits.

By Reginald E. Hore, Houghton, Mich.

The gold at Porcupine occurs chiefly in pyritic quartz. In lesser amounts it is found in the country rocks.

The quartz in most cases is white in colour, with reddish-brown patches of iron oxides. Less commonly, but including some spectacular veins, the colour is greyish-blue.

The gold is, in part, coarse and readily visible to the naked eye. In most of the quartz, however, it is very fine. The greater part, 50 to 65 per cent., is readily won on crushing. A smaller percentage is more intimately allied with sulphides and will probably be treated by cyanidation.

The country rock is usually either pyritic grey schist or rusty-weathering mixed carbonates. Less often it is a conglomerate.

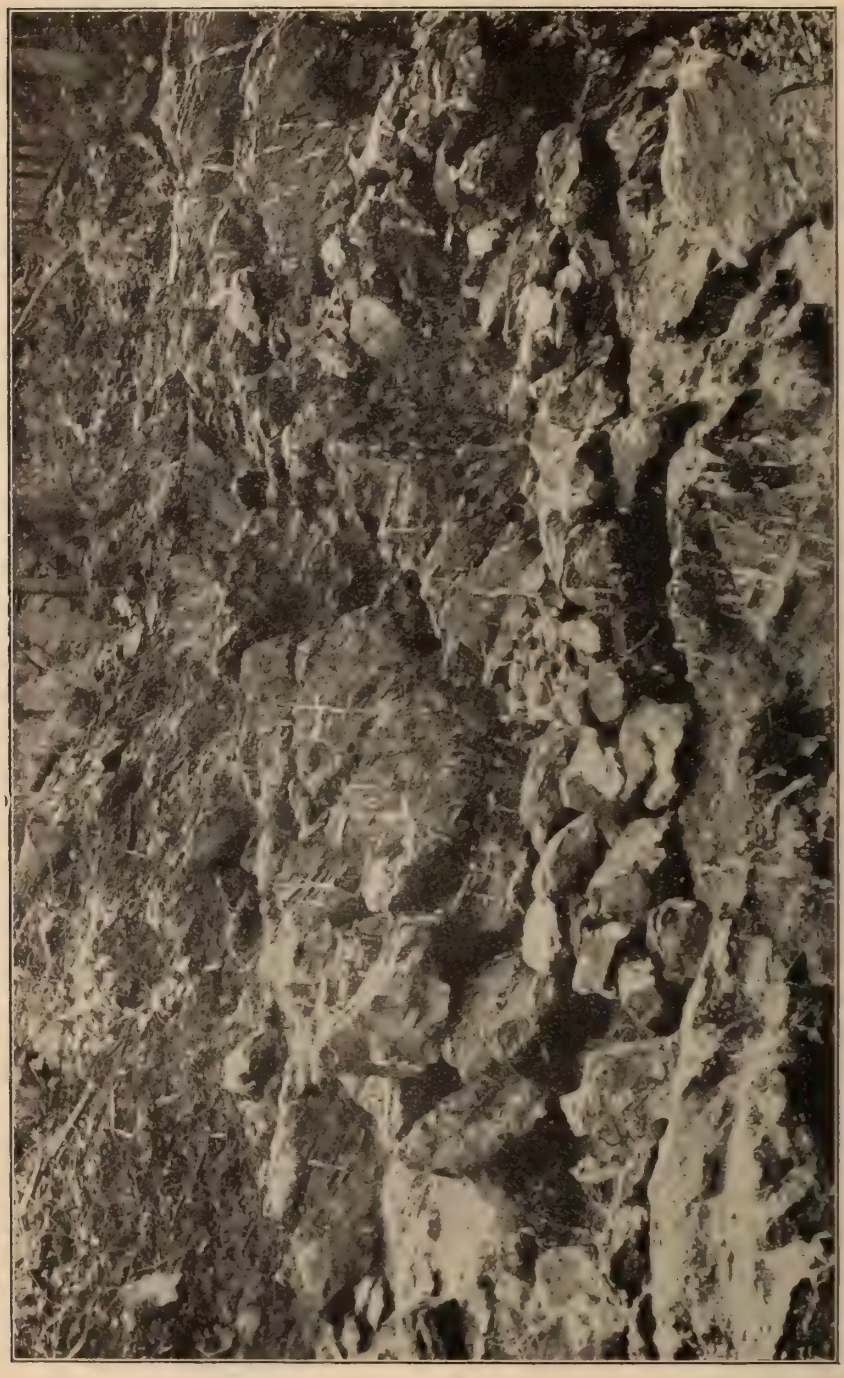
The schistose country rocks are for the most part altered volcanics, and are of various types. Many are sericitic and all are impregnated with carbonates. Small cubes of pyrite are usually abundant. Copper pyrite occurs; but in very subordinate quantity.

The carbonate rocks are grey to yellowish-grey, crystalline and massive. They are iron—calcium—magnesium carbonates, such as are common in the iron formations of Ontario and the Lake Superior states. Such rocks range in composition from siderite through ankerite to dolomite, and on the iron ranges are called ferro-dolomite. The percentage of iron in the Porcupine rocks, as in most Keewatin carbonates, is less than in normal ankerite.

The conglomerate is composed of light-coloured pebbles of various types set in a fine grey coloured matrix. An arrangement of the pebbles with their longer dimensions parallel, gives a decided schistose appearance.

Form of the Deposits.

The deposits vary greatly in shape. Some appear at the surface to be well defined single fissure fillings or veins. In some cases there is a series of fissure fillings running nearly parallel and enclosing large and small masses of rock. These are conveniently referred to as vein systems. In another type numerous quartz veins run through ferrodolomite beds. We may designate these as ferrodolomite lodes. There are also large quartz masses of irregular and unknown form, which cannot be well designated as veins or lodes. They appear to be lenticular rather than tabular in shape. From the nature of outcropping surfaces, they have been called "domes." Until their true character is known, it seems best to refer to them as quartz masses.



Quartz Ferrodolomite Lode—Foster Claims. Quartz Veins in Ferrodolomite.

Quartz Ferrodolomite Lode—Foster Claims. White Bands of Quartz Stand Out. In Relief from Rusty Ferrodolomite.

These four types may be illustrated by description of four claims in Tisdale Township. For a single quartz vein we may take one on the Connell property. A system of quartz veins is exposed at the Timmins mine. The most striking example of quartz ferrodolomite lode is the Foster. A remarkably large quartz mass or "dome" is that at the Dome mine. None of these deposits has been thoroughly explored, and observations on their nature must therefore be confined almost entirely to superficial characters. The Dome is being tested by drifts and cross-cuts at the 60-foot level(and by diamond drilling to a few hundred feet. One of the veins at the Timmins is being

Quartz Vein, Connell Claim. Showing Well Defined North Wall.

drifted on at the 100-foot level. The Foster lode and the Connell vein have each been carefully stripped; but neither has yet been tested for more than a few feet in depth.

Quartz Vein.

The deposit selected as an example of this type is located on the Connell claims, just south of the centre of Tisdale Township. The vein has been exposed almost continuously for over 200 feet. At the western exposure it is 15 inches and at the eastern, where it dips into low ground, 5 feet wide.

The quartz is milky-white and vitreous. Where it has been directly exposed to the weather, it is coated with yellowish-brown iron oxides. Streaks and patches of this secondary material are found filling small cavities and crevices for a few feet downwards. Portions of the vein which were protected by a mantle of soil, show similar alteration, but to a much less degree. Some such portions show

Quartz Mass, Dome Mine. All Quartz except at lower left corner.

Quartz Mass, Dome Mine. Showing nature of Contact.

Quartz Veins, in Grey Schists, Timmins Mine. This illustrates, in miniature, a Vein System.

scarcely any weathering and appear brilliantly white in the sunlight.

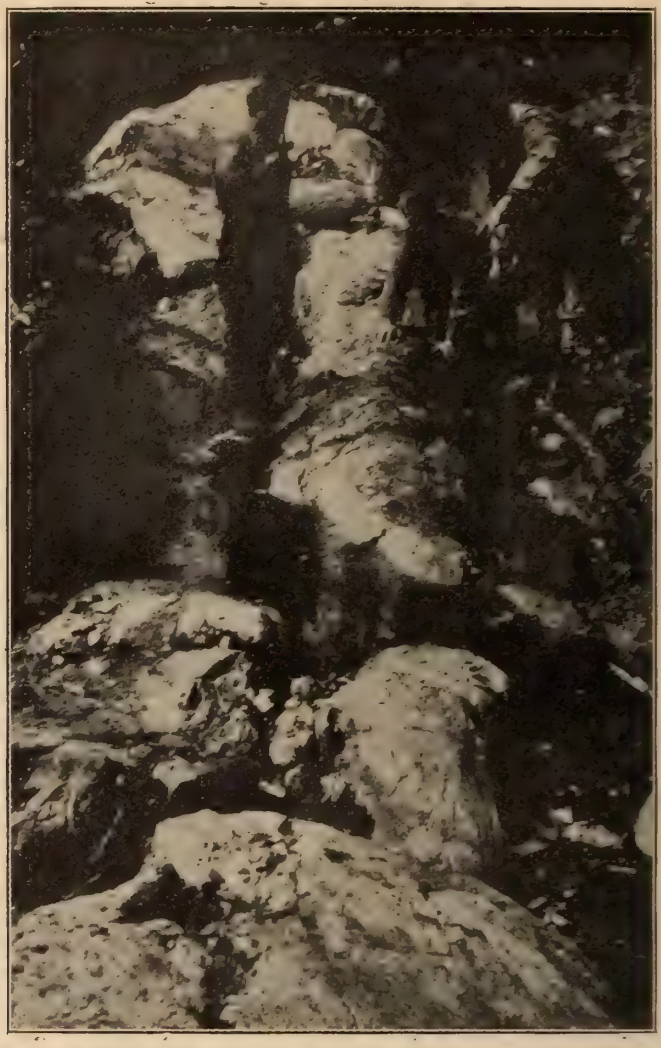
Free gold can be seen for several feet along the vein. It is coarse and readily detected by the naked eye. The most spectacular and richest portion is a streak about 15 inches wide on the north side of the vein. Here countless particles of coarse gold appear on the sur-

Quartz Mass, Dome Mine.

face. It occurs especially in rusty cavities and in minute dark streaks, which fill crevices in the quartz. The gold particles are even more numerous, however, on the vein wall. This wall is very clean cut, and has but a thin selvage of dark greenish colour. It is slickensided and shows pronounced grooves running nearly vertical. These grooves, running normal to the undulatory strike, produce a decidedly corrugated surface, as may be seen in the accompanying photograph.

The wall rock is a rusty weathering ferrodolomite. At the immediate contact it is disintegrated for a foot in depth. A foot or more from the contact it is quite massive, except for a few inches at the surface. The fresh rock is of light grey colour, finely crystalline and soft. It effervesces slowly with dilute acid. Scattered through it are striated cubes of pyrite. Veinlets of white quartz penetrate in all directions.

The carbonate on the north wall is only a few feet wide, and is succeeded by dark-coloured, fine-grained porphyritic igneous rocks. South of the vein the rocks are not exposed.



Quartz Vein, Connell Claim. Rich Streak containing coarse gold in centre.

Quartz Vein System.

At the Timmins mine there are a number of large quartz veins striking in a northeasterly direction. Some of them are but a short distance apart, and appear to converge and enclose large masses of rock. Others running parallel, and supposedly of the same vein system, are 200 feet and 400 feet apart. The larger members of the system themselves enclose numerous fragments of schist similar to the country rock. This vein system appears to be part of a larger veined zone, which extends northeast to and north of Pearl Lake.

The quartz is in most of the veins white in colour, except where stained brown with iron oxides. An exception is a vein of greyish-blue colour, which cuts across one of white quartz. The veins are commonly 4 feet to 10 feet wide, and one vein, now being developed

Dome Mine. Shows Veins in Schists near Large Quartz Mass.

Hollinger Mine, Nodular Quartz Masses in Crumpled Grey Schists.

Hollinger Mine. White Quartz in Grey Schists.

from two shafts 250 paces apart, is 8 feet to 15 feet wide. There are a large number of veins which show free gold on the surface, generally in rusty patches or in minute fractures. The ore from a few feet below the surface is remarkably free from iron stains, and the pyrite crystals have scarcely any tarnish. Ore impregnated with particles of coarse gold has been taken from a drift at the 100-foot level, and it is more spectacular than any of the surface showings. The workings are in ore at almost all points, and the ore is high grade.

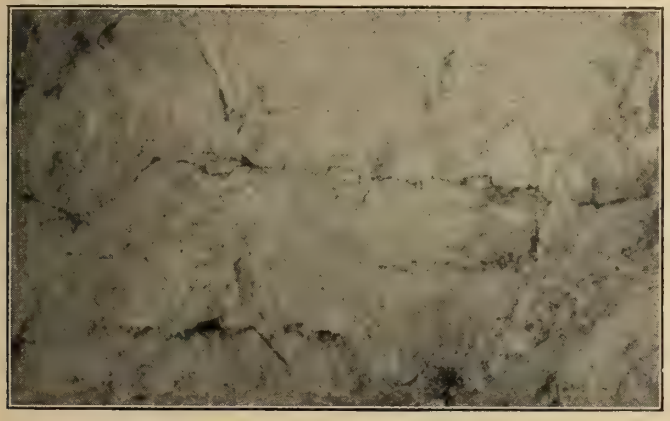
The wall rock is a grey pyritic sericite schist impregnated with carbonates. The pyrite occurs both as small cubes scattered through the rock, and in less perfect crystals in little veinlets. Mr. C. W. Knight has suggested that the schist is an altered phase of quartz porphyry, which occurs in the vicinity. It is similar to, but not so

Hollinger Mine, one of the larger Veins, showing decided Tabular Shape.

siliceous, as some of the sericite schists at Temagami, which Dr. Barlow showed to be mashed quartz porphyry.

It is as yet impossible to trace out the individual members of the vein system. Many of the outcrops are small and separated by low ground. The strike of veins on neighbouring outcrops is frequently too divergent to permit the interpolation. Considerable stripping has been done and a few veins traced continuously for several hundred feet.

A remarkable outcrop is the greyish-white quartz "dome" beside which No. 1 shaft has been sunk. For the greater part it shows, as may be seen from one of the accompanying photos, a marked similarity to some marbles. In places it is stained with iron oxides, and in such rusty patches are many particles of coarse gold. The exact relation of this mass to the vein in the shaft is not evident. From the far side of the shaft house, a vein 3 feet wide, runs northeast for a few paces along the edge of the stock pile, and then is lost in low ground. Several hundred feet along the strike another outcrop shows similar quartz. Southwest from No. 1 shaft there are fairly continuous outcrops of quartz, which are probably parts of one vein, and



Hollinger Mine. Face of White Quartz Mass at No. 1 Shaft.

Hollinger Mine. Showing Quartz Vein in Grey Schists. Stockpile at Left.

which have been tested by two shafts. From the further shaft a drift is being made at the 100-foot level towards No. 1.

In some outcrops east of No. 1 shaft, a variety of structure is shown by quartz veins in the schists. In some places the veins cut distinctly across the foliation of the country rock. In others there are veins of similar quartz, which conform closely to the schistosity and terminate abruptly in the sharp folds.

Quartz-ferrodolomite Lode.

On the Foster claims gold occurs in quartz veins which run through a band of rusty weathering ferrodolomite. The largest lode has been stripped for about 250 paces. It shows a width of 5 feet to 20 feet, and for a considerable proportion of its length, averages over 10 feet.

The quartz stands out in relief from the more deeply weathered, red brown, oxidized ferrodolomite. Several quartz bands, 4 inches to 10 inches wide, run normal to the strike of the lode, and the carbonate is impregnated with a multitude of very small quartz veins. Many of the latter occur in two sets which divide the carbonate into

Hollinger Mine. Showing Contact of Quartz with Grey Schists.

small rectangular blocks.

The quartz is white in colour, but stained with iron oxides. The red rust comes partly from the oxidation of small pyrite crystals, which are abundant in patches of the quartz, and in part from the weathering of the ferrodolomite. In some of the rusty crevices there are spectacular showings of coarse gold.

The lode strikes nearly due west. The country rock is a pyritic grey schist impregnated with carbonates.

Quartz Masses.

At the Dome mine a smooth hummocky outcrop glistens white in the sunlight. It is chiefly made up of huge masses of quartz which enclose large and small fragments of grey schist. The country rocks are grey sericite schist, grey slate and a schistose conglomerate.

One mass, which is almost entirely quartz, has a surface area 100 feet by 200 feet, and there are numerous smaller masses of elliptical plan. An oval-shaped area, including much country rock, but of which about one-half is quartz, is 600 feet by 200 feet. In addition to the large masses, there are numerous veins one foot to three feet in width, which penetrate the country rock. Some of these are almost conformable with the schistosity, but many cut distinctly across it.

The dome-shaped masses show rather varied relations to the enclosing rock. In some cases the contact is nearly vertical, while in others it is but gently inclined. The boundaries are seldom nearly straight lines, but elliptical or circular.

Coarse gold shows at several places on the surface. It, together with pyrite, is especially abundant in the vicinity of enclosed schist or the country rock. A large tonnage of quartz carries workable quantities of fine gold. The pyritic schist itself is known to carry some gold values. Small striated cubes of pyrite are abundant in both the schist and the quartz. Copper pyrites also occurs, but is probably not in such quantity as to interfere seriously with the recovery process.

Equipment at Porcupine

The following list of equipment already installed, or about to be installed, was furnished to the CANADIAN MINING JOURNAL by Mr. Alexander H. Smith, mining engineer, now resident in Porcupine. The list is not entirely complete, but it is nearly enough right to indicate the conditions of affairs early in April. Hardly any more additions will be made until after the railway is complete. Any omissions that may be noted have, of course, been made unintentionally.

List of power plants, etc., Porcupine Gold District, April, 1911—erected or under construction:

1. Armstrong-Booth—Boiler, hoist, and drills.
2. Armstrong-McGibbon—3-drill Rand Compressor, boiler, hoist, and drills.
3. Bewick-Moreing No. 1—5-drill Rand compressor, 6 drills, boilers, hoists, etc.
4. Bewick-Moreing No. 2—5-drill Rand compressor, 6 drills, boilers, hoists, etc.
5. Burns (Shaw)—10-stamp mill ordered, with necessary equipment.
6. Crown Chartered No. 1—3-drill Rand, boiler, hoist, drills, one McKiernan-Terry shot drill.
7. Crown Chartered No. 2—Boiler and hoist.
8. Duncan Chisholm—One McK.-T. shot drill.
9. Dome—40-stamp mill, 1 Nissen stamp, cyanide plant, power plant, compressor, etc.—largest plant in camp.
10. Dome Extension—3-drill Rand, boilers, hoist, drills, one McK.-T. shot drill.
11. "Foster" West Dome—Compressor, boilers, hoist, drills, and 4 McK.-T. shot drills.
12. Foley-O'Brien—3-drill compressor, boilers, 2 McK.-T. shot drills, hoist, and drills.
13. Feldon—Reported 2 shot drills.
14. Hollinger—30-stamp mill, concentrating mill, 1 Tremaine steam stamp, boilers, compressor, hoists, etc.
15. Imperial—Boiler and hoist.
16. McEniney—Boiler, hoists, and drills.
17. Philadelphia—Boiler, hoists, and drill.
18. Preston-East Dome—5-drill Sullivan compressor, boilers, hoists, drills, 2 Nissen stamps.
19. Pearl Lake—2 boilers, 2 hoists, 2 drills, one McK.-T. shot drill.
20. Goldfields Consolidated ("Rea")—5-drill compressor, boilers, hoists, drills, one McK.-T. shot drill.
21. Standard—Boiler, hoist, 1 drill.
22. Scottish-Ontario—Boiler and hoist.
23. James Whalen—Boiler and hoist.
24. Vipond—Compressor, boilers, hoist, and one Nissen stamp.

In addition to the above, we have ascertained that four additional McKiernan-Terry shot drills have been installed on properties not mentioned in the list. These properties belong to Thor Warner, B. Babayan, Cobalt Townsite Mining Company, and Catlin Powell Company.

One View of Porcupine

From our valued contemporary, the Mining Journal of London, we reprint the following remarks concerning Porcupine. The tone of the letter, which was written by the Journal's New York correspondent, is sound and the criticisms appear not unduly harsh.

THE PORCUPINE BOOM—For the past twelve months romantic stories of fabulously rich quartz veins have been issuing from the wilds of Northern Ontario, and, unless all signs fail, the campaign of educating the public through the press will be sufficiently advanced in the course of the next two or three months to permit of the launching of the Porcupine boom.

When the Cobalt field was first opened up, engineers for the most part reported adversely on the camp, and many of those who reaped the advantage of the richness of these unique deposits were people who had little or no previous experience in mining, and who, by the fortunate investment of a few hundred or a few thousand dollars, became rich within a short period of time. The great richness of the ore veins at Cobalt, and the proximity of the camp to the populous cities of the eastern part of the United States and Canada, caused the wildest sort of excitement, and set up a standard of prices never before witnessed, except in the early days of the Comstock lode.

Following the discoveries of gold-bearing quartz in Porcupine less than two years ago, it was quite natural that the first people to interest themselves in the camp should be the mine operators of Cobalt, only a short distance away. These immediately applied the Cobalt scale of prices to undeveloped mining claims, thousands of dollars being asked for swamp land without even an indication of mineral. The readers of the Journal are already familiar with the geology and general character of the deposits at Porcupine.

The greatest secrecy has prevailed regarding the results of development work that has been carried on in the Timmins and Dome properties. The enormous quartz outcrop at the Dome property, with its spectacular showings of free gold, stimulated the imagination of many people, and the vague statements—and contradictory ones, too—that have from time to time been published, have only served to enhance the mystery surrounding this supposed to be fabulously rich property. A few people, perhaps, are in possession of the actual facts regarding the value of the ore proved by the development work in the Dome. The high standing of the group of financiers who control this property lends colour to all the stories published, despite the fact that the owners have never made a public statement about the values disclosed by the development.

The Hollinger mines, belonging to Timmins, et al, share equally with the Dome in the romance of Porcupine.

The publicity agents of the district have assiduously informed the interested world every time an engineer of note has come into the district in the past six months. William Frecheville's name was published

far and wide as indicating the interest London financiers were taking in the camp. When the Consolidated Gold Fields of South Africa entered the field there was a blare of trumpets, and daily the press is filled with announcements of transactions which are supposed to indicate the great richness of the field.

Aside from the recently published statement by Mr. Timmins, as president of the Hollinger mines, there has been no definite statement made by anyone in authority as to the assay value of any of the ore opened up. The general character of the statements regarding the ore is that there are spectacular showings and rich development. As a matter of fact, the Porcupine deposits are by no means peculiar to that section of the world, but have been exploited with indifferent success elsewhere, and absolutely reliable information, based on results of sampling, indicate that most of the engineers who have visited Porcupine have turned the camp down.

According to the statement of Mr. Timmins above mentioned, on the Hollinger mine there have been some 1,400 feet of development work. Based on this meagre amount of development, it is stated that the average assay value of the ore is $49 per ton. According to the "Boston News Bureau," the Hollinger has $3,000,000 in sight in a high grade vein of quartz averaging 8 feet in width, which has been developed for 1,300 feet in length on the 100-foot level. Any estimate of ore reserves on the Hollinger must be taken with caution. There are only three shafts on the property on the main ore zone, one of which has not been sunk to the 100-foot level. Before any accurate estimate of ore reserves can be made, a great deal of additional work must be done.

Recently 100,000 shares of this company were offered at $3.50 per share, and the price has since risen to about $8, giving a market value to the property of $4,800,000. It is safe to say that the amount of development work done does not warrant any such valuation of the property, and in view of the meagre amount of information regarding the character of the ore deposits at Porcupine, $8 for these shares is unwarranted.

The people interested in the Dome property have a record of success behind them in the mining world, which should go a long way in reassuring one that the property has merit. If the statements regarding the developments of the Dome property are to be believed, according to the "Boston News Bureau," an ore body 600 feet long by 350 feet wide, having an average assay value of $10 per ton, has been opened up at the 40-foot level. An ore body of these dimensions would contain 600,000 tons for every 40 feet vertical in depth. At the present time a 40-stamp mill is being erected on the property, which may be expected to crush about 75,000 tons per annum. In other words, the 600,000 tons stated to exist above the 40-foot level will take about eight years to mine. Diamond drill holes are stated to have proved the continuation of values at considerable depth. An analysis of this situation leads to the inevitable conclusion that an ore body of such dimensions and value would be attacked in an entirely different manner, considering the experience and financial ability of the owners.

We have yet to learn that a mine valuer of standing had made a report giving values which may be used by the public as a gauge of the

merit of the properties reported on. It is likely that the astute people who are interested in the Dome and Timmins properties are fairly well convinced that they have properties of merit, and they most certainly expect to make either out of the share market or the mines. But this is a long way from proving that everyone or any of the other extremely numerous outcrops of the camp will prove of value; and a warning signal should be hoisted as a guide to the investing public that they must be careful lest they be bitten by the numerous flotations which are sure to come, and which will be placed before them in an attractive form inviting them to participate in the enormous wealth supposed to exist in Porcupine.

The history of gold mining in Eastern Canada has been one of uniform financial failure; and if for no other reason caution should be exercised regarding the Porcupine field until developments have reached such a stage as to indicate with absolute certainty the possibilities of the district, not only superficially, but in depth. Lenticular bodies of quartz showing gold do not necessarily make paying mines.

Directory

Note.—This directory is in no sense complete. It is intended as a rough guide.

AMERICAN GOLDFIELDS, LIMITED.

Authorized Capital—400,000 shares, par value $5 each. All issued.
Location—Two claims in southwest Tisdale.
Transfer Agents—Union Trust Company, Toronto; Bankers Trust Company, New York.

Board of Directors—Edward Steindler, New York, President; H. C. Rowley, Vice President; P. J. Steindler, Secretary-Treasurer; H. W. Meed, Toronto; Colonel H. Trotter, Montreal.

APEX GOLD MINING COMPANY, LIMITED.

Authorized Capital—$2,000,000, par value of shares, $1.00.
Location—80 acres Tisdale Township, known as Bilsky Claims.
Treasury has 700,000 shares and about $60,000 in cash.
Transfer Agents—Trust & Guarantee Company, Toronto.
Two claims situated in Tisdale, between the Hollinger and Dome.

CORONATION GOLD MINES, LIMITED.

Authorized Capital—$1,000,000, par value of shares, $1.00.
Issued to Vendors—500,000 shares.
Treasury—500,000 shares.
Location—120 acres in Whitney Township.
Transfer Agents—Trust & Guarantee Company, Toronto.

Board of Directors—K. K. Martin, Toronto, President; F. S. Wood, Niagara Falls, Vice-President; C. Taylor, St. Catharines, Ont.; M. W. Bennett, Buffalo, N.Y.; O. Leslie, Toronto, Acting Secretary.

CROWN CHARTERED MINES, LIMITED.

Authorized Capital—$2,000,000, par value of shares, $1.00.
About 100,000 treasury shares issued, leaving a balance of over 400,000 shares still in the treasury.
At the meeting, Feb. 11, a balance of $3,000 cash was also in the treasury.
Location—200 acres in different parts of Tisdale Township.
Transfer Agents—Security Transfer & Register Co., 66 Broadway, New York.

Board of Directors—O. L. Henault, Montreal, President; Jno. P. Hefferman, Montreal, Vice-President and Secretary-Treasurer; J. H. Garlaneau, Montreal; L H. Henault, Montreal; P. C. Ryan, Montreal; M. S. Stephenson, Montreal.

THE DOBIE MINES, LIMITED.

(Armstrong & McGibbon.)
Authorized Capital—$1,500,000, par value of shares, $5.00.
Location—120 acres in Tisdale Township.
Transfer Agents—Toronto General Trusts Co., Toronto.

Board of Directors—Frank C. Armstrong, New York, President; E. P. Earle, New York, Vice-President; D. Lorne McGibbon, Montreal; Hon. Wallace Nesbitt, Woodstock; Samuel Dobie, Toronto; Chas. Watson, Mine Manager.

DOME MINES, LIMITED.

Capital—$2,500,000, divided into 250,000 shares of a par value of $10 each.
Head Office—58 Wellington St. East, Toronto.
Location—Six claims in Lots 4 and 5, concession 1, Tisdale Township.

Directors—W. S. Edwards, Toronto, President; Ambrose Monell, New York, Vice-President; Alexander Fasken, Toronto, Secretary; C. S. Dennison, New York; James Ashley, New York.

DOME EXTENSION MINES COMPANY, LIMITED.

Authorized Capital—$2,000,000, par value of shares, $1.00.
Issued—1,500,000 shares.
Treasury—500,000 shares.
Location—200 acres in Tisdale Township.
Transfer Agents—Trust & Guarantee Company, Toronto.

Board of Directors—W. S. Edwards, Chicago, President; Alex. Fasken, Toronto, Secretary; J. S. Wilson, Massey, Ont.; Jas. Playfair, Midland, Ont.; S. B. Morris, Rodney, Ont.; H. C. Anchor, Mine Manager.

FOLEY-O'BRIEN MINES, LIMITED.

Capital—3,000,000, par value of shares, $5.00.
Treasury—200,000 cash and 100,000 shares of stock.
Location—500 acres in Tisdale Township.
President—P. N. L. Foley.
Manager—C. W. Geddes.
Transfer Agents—Union Trust Co., Toronto.

HOLLINGER GOLD MINES, LIMITED.

Authorized Capital—$3,000,000, par value of shares, $5.00.
Treasury—100,000 shares.
Location—160 acres in Tisdale Township.
Transfer Agents—Toronto General Trusts Co., Toronto.

Board of Directors—N. S. Timmins, Montreal, President; John McMartin, Cornwall, Vice-President; D. A. Dunlop, Toronto, Secretary-Treasurer; L. H. Timmins, Montreal; Duncan McMartin, Montreal.

JUPITER MINES, LIMITED.

Authorized Capital—$2,000,000, par value of shares, $1.00.
Treasury—1,500,000 shares.
Location—80 acres in Tisdale Township.
Transfer Agents—Trust & Guarantee Company, Toronto.

Board of Directors—Major J. A. Murray, Toronto, President; Chas. Vane, Porcupine, Vice-President; G. W. Bartlett, St. John's, Newfoundland; Edward O'Kelly, Toronto; James Pearson, Toronto.

MONETA MINES, LIMITED.

Capitalization—$2,000,000, par value of shares, $1.00.
Treasury—800,000 shares and about $37,000 cash.
Location—120 acres in Tisdale, immediately west of the Hollinger.
Transfer Office—Toronto General Trusts Co., Toronto.

Board of Directors—Sir Henry M. Pellatt, Toronto, President; D. M. Steindler, New York, Vice-President; A. M. Bilsky, Montreal; A. G. Kirby, Cobalt, Ont.; D. S. Friedman, Montreal.

NIAGARA PORCUPINE MINING CO., LIMITED.

(Bewick-Moreing Company.)

Authorized Capital—£400,000, par value of shares, £1.
Issued—100,000 shares.

Board of Directors—Earl of Erroll, London, Eng., Chairman; John Barry, London, Eng., Vice-Chairman; John Richards, London, Eng.; Sir W. Bell, London, Eng.: C. A. Moreing, London, Eng.

NORTHERN ONTARIO EXPLORATION COMPANY.

Authorized Capital—400,000 shares, par value £1 each. All issued for cash.
Property—Under the direction of Messrs. Bewick, Moreing & Co. this company took over 50 claims of the Timmins-McMartin-Dunlap Syndicate and acquired a block of shares in Hollinger Gold Mines, Ltd.
Head Office and Transfer Office—20 Copthall Avenue, London, E.C.

Directors—The Right Hon. the Earl of Errol, Chairman; John Barry, Vice-Chairman; Sir William Bell, Charles Algernon Moreing; David Richards, Managing Director.

THE NORTHERN EXPLORATION COMPANY.

Authorized Capital—$2,000,000, par value of shares, $1.00.
Treasury—$1,000,000, of which 300,000 shares have been issued.
The vendors receive 1,000,000 shares for the property.
Location—260 acres in Deloro Township.

Officers—R. W. Norrington, Toronto, President; Paul A. Schoelkopp, Niagara Falls, Vice-President.

PEARL LAKE MINING COMPANY.

Capitalization—$2,500,000, par value of shares, $1.00.
Location—127 acres in Tisdale Township.
Transfer Office—Trust & Guarantee Co., Toronto.

Board of Directors—Burr E. Cartwright, Haileybury, President; R. A. Cartwright, Ridgeway, Pa.; M. R. Cartwright, Haileybury; J. P. Bickell, Toronto; P. W. Cashman, Haileybury, Secretary; B. Wolfram, Mine Manager; Mr. Fisher, Consulting Engineer.

PORCUPINE GOLD MINES, LIMITED.

Authorized Capital—2,000,000 shares, par value $1.
Treasury—1,686,036 shares.
Location—Nine claims in Tisdale Township and two claims in Mountjoy Township. The groups are known as the Vipond and Airth claims, the Atchison-McDougald claims, and the Mountjoy claims.
Head Office—Marbridge Building, New York.
Transfer Agents—Columbia Trust Company.

Directors—H. H. Ward, Washington, D.C., President; W. B. Ridgely, Vice-President, Washington; C. C. Dickson, New York, Secretary-Treasurer; C. W. Hitchcock, Cleveland; E. B. Waples, Wilmington, Del.

PORCUPINE GOLD REEF MINING COMPANY.

Capitalization—$1,000,000, par value of shares, $1.00.
Treasury—500,000, of which 100,000 have been underwritten at 25c.
Acreage—80 acres in Whitney Township.
Transfer Office—Trust & Guarantee Co., Toronto.

Board of Directors—Jas. Coulter, Toronto, President; Nelson Lart, M.D., Toronto, Vice-President; J. H. Stephens, Toronto; H. Yeomans, Toronto; M. F. Lynch, Toronto.

PORCUPINE IMPERIAL GOLD MINING CO.

Head Office—42 Broadway, New York.
Capitalization—$2,000,000, par value of shares, $1.00.
Treasury—1,000,000 shares.
Location—42 acres in Deloro Township.

Board of Directors—H. L. Taylor, New York, President; R. W. Norrington, Toronto; E. J. Sweetland, New York; L. E. Wales, New York; P. S. Moontague, New York, Secretary.

PORCUPINE LAKE GOLD MINES, LIMITED.

Authorized Capital—$1,000,000, par value of shares, $1.00.
Treasury Shares—250,000, of which 100,000 have been issued.
Location—About 78 acres in Tisdale, bordering on Porcupine Lake.
Transfer Agents—16 King Street West, Toronto.

Board of Directors—Hon. P. Talbot, Ottawa, President; Donald McGillivary, Port Colborne, Vice-President; James A. Scaugale, Dawson City; John S. McCullough, Toronto, Secretary-Treasurer.

PORCUPINE NORTHERN MINING COMPANY.

Authorized Capital—$1,000,000, par value of shares, $1.00.
Treasury—600,000 shares, of this 150,000 shares are being offered by public subscription at 50 cents per share.
Location—12 claims in Tisdale, 4 claims in Whitney.
Transfer Agents—Empire Trust Co., 42 Broadway, New York.

PORCUPINE TISDALE MINING COMPANY.

Capital—$2,000,000, par value of shares, $1.00.
Location—200 acres in Tisdale Township and 90 acres in Deloro Township.
Transfer Agents and Head Office—Cobalt, Ont.

Board of Directors—W. B. Gunton, Haileybury, President; F. L. Cody, Cobalt; C. C. Green, Haileybury; A. B. Iliffe, Haileybury, Secretary-Treasurer.

PORCUPINE TOWNSITE MINES, LIMITED.

Capital—$1,000,000, par value of shares, $1.00.
Location—80 acres in Whitney Township.
Transfer Agents—Union Trust Co., Toronto.

Board of Directors—C. J. Musson, Toronto, President; Chas. T. Lunt, New York, Vice-President; A. J. Gillies, Toronto; Hon. Amos H. Stephens, New York; Geo. Gouinlock, Toronto.

PRESTON EAST DOME MINES, LIMITED.

Authorized Capital—$3,000,000, par value of shares, $1.00.
Issued—2,000,000 shares.
Treasury—500,000 shares and about $150,000 in cash.
Location—120 acres in Tisdale Township, adjoining the Dome, and 49 acres immediately south in Deloro Township.
Transfer Agents—Toronto General Trusts Co., Toronto.

Board of Directors—E. G. Germer, Erie, Pa., President; Joseph H. Ellis Louisville, Ky., Vice-President; Lieut.-Col. D. M. Robertson, Toronto; W. E Preston, Midland; D. L. White, Midland; D. F. McGuire, Toronto, Secretary; S M. Thorne, Mine Manager.

REA CONSOLIDATED GOLD MINES, LIMITED.

(The Consolidated Gold Fields of South Africa.)
Capitalization—$1,000,000, par value of shares, $5.00.
Treasury—$200,000.
Location—320 acres in Tisdale Township.
Transfer Agents—Toronto General Trusts Co., Toronto.

Board of Directors—C. P. Hill, Montreal, President; W. W. Butler, Montreal, Vice-President; H. Lockhart, Jr., New York; T. H. Rea, Chicago; J. B. Holden, Toronto; D. Richards, London, Eng.; L. C. Thompson, New York.

ROYAL PORCUPINE GOLD MINES, LIMITED.

Incorporated under the laws of Delaware.
Capital—$3,000,000, par value of shares, $1.00.
Treasury—1,000,000, of which 100,000 are being offered to the public at 30 cents.
Location—320 acres in Tisdale Township.
Transfer Agents—Security and Transfer Co., 66 Broadway, New York.

Board of Directors—James Kendry, Peterboro, Ont., President; Jacob Rapont, New York, Vice-President; Sydney Berubeim, New York, Treasurer; T. E. Bradburn, Peterboro, Ont.; Archibald A. Allan, New York; Hamilton Kilgour New York and London; Warren N. Akers, Wilmington, Del.; B. E. C. Von Riper, Secretary.

SCOTTISH ONTARIO GOLD MINING SYNDICATE, LIMITED.

Capital—Close corporation.
Location—Six claims in Lots 11 and 12, concessions 4 and 5, Township of Whitney.
Head Office—Dunlap & Murray, Glasgow, Scotland.

STANDARD GOLD MINES, LIMITED.

Capital—$1,500,000, par value of shares, $1.00.
Location—63 acres in Deloro Township.
Transfer Agents—179 St. James Street, Montreal.

Board of Directors—T. O. Lyall, Montreal, President; D. J. J. Guerin, Montreal, Vice-President; W. Carruthers, Montreal; R. B. Hutcheson, Montreal; Wm Geraphty, Montreal; S. C. Wallace, Montreal, Secretary.

SWASTIKA MINING COMPANY, LIMITED.

Authorized Capital—$2,000,000, par value of shares, $1.00.
Location—195 acres in Otto Township.
Transfer Agents—Union Trust Company, Toronto.

Board of Directors—A. T. Bell, Tavistock, Ont., President; D. M. Steele, Tavistock, Ont., Secretary-Treasurer; F. W. White, Toronto, Ont.; James Dusty, Toronto, Ont.; George Reid, Tavistock, Ont.

TISDALE GOLD MINING COMPANY, LIMITED.

Authorized Capital—100,000 shares, par value $5 each. All issued.
Location—Two groups of claims, 17 in all, in concessions 1, 2, and 5 in Tisdale Township.
Head Office—Porcupine, Ont.

Directors—Frank C. Armstrong, New York, President; E. P. Earle, Vice-President; D. Lorne McGibbon, Montreal; Samuel J. Dobie, Haileybury; Hon. Wallace Nesbitt, Toronto; S. J. Le Huray, Secretary-Treasurer, Montreal.

UNITED PORCUPINE GOLD MINES, LIMITED.

Capitalization—$1,500,000, par value of shares, $1.00.
Issued—500,000 shares at 10 cents.
Location—320 acres in Whitney Township.
Transfer Office—Traders Bank Building, Toronto.

WEST DOME MINES, LIMITED.

Authorized Capital—$3,000,000, par value of shares, $5.00.
Treasury—100,000 shares and approximately $250,000 cash. 400,000 shares were paid to the vendors for the property, and 100,000 shares sold to the underwriters.
Location—About 200 acres, adjoining the famous Dome Mine in Tisdale Township

Board of Directors—Sir Henry M. Pellatt, Toronto, President; Charles Warfield, New York, Vice-President; F. Augustus Heinze, Managing Director; A. M. Ballantyne, Toronto; Hugh Blain, Toronto; G. F. Morrison, Toronto, Secretary-Treasurer.

Proposed Reduction Plant of the Dome Mines Syndicate, Porcupine, Ontario.

So much has been written concerning the formation and ore deposits of the Porcupine district that a few points regarding the milling properties of the ore, so far as we know them, may be of interest. A discussion of the probable metallurgy in detail would be somewhat premature, so an attempt will be made to bring out only some of the more important results of experiment and give a general outline of the plant which is being installed on the Dome.

During the spring of 1910, a small mill was erected consisting of 1,500-pound Nissen stamp, a 4 ft. by 8 ft. amalgamating plate, and a Deister concentrating table. Weighed quantities of average ore were milled and the work supplemented by laboratory tests to determine a process suitable to the ore.

The ore, which is essentially quartz and greenstone schist, carrying free gold and iron pyrite, was at first considered to be an ideal concentrating ore. The gold was closely associated with the iron pyrite and a high grade concentrate could be obtained. The tailings, however, were sufficiently valuable to warrant cyaniding. By regrinding the concentrate, it was found that a large percentage of the gold could be recovered by amalgamation. The idea of concentration was then abandoned and experimental work was confined to sliming the whole product by two stage crushing, amalgamating after each and cyaniding the tailings. By grinding to 90 per cent. through a 200-mesh screen, 84 per cent. of the gold was recovered by amalgamation. The ore was particularly free from cyanides, the only difficulty arising from the presence of a small amount of carbonaceous material which caused a secondary precipitation. This was overcome by lengthening the period of agitation.

By the middle of August, 1910, sufficient ore had been developed to justify the building of a mill. The stamp mill and cyanide practice of the Western United States was investigated and typical mills were visited. A shipment of ore was made to the Merrill Metallurgical Company, of San Francisco, Cal., as the Merrill system had been decided upon for the secondary treatment. Mill runs were made at their experimental plant and the milling properties of the ore thoroughly tested. The results were so encouraging and the ore so amenable to the treatment that it was decided to take advantage of the winter roads and ship the plant in during the present winter. The Merrill Metallurgical Company was retained to design it.

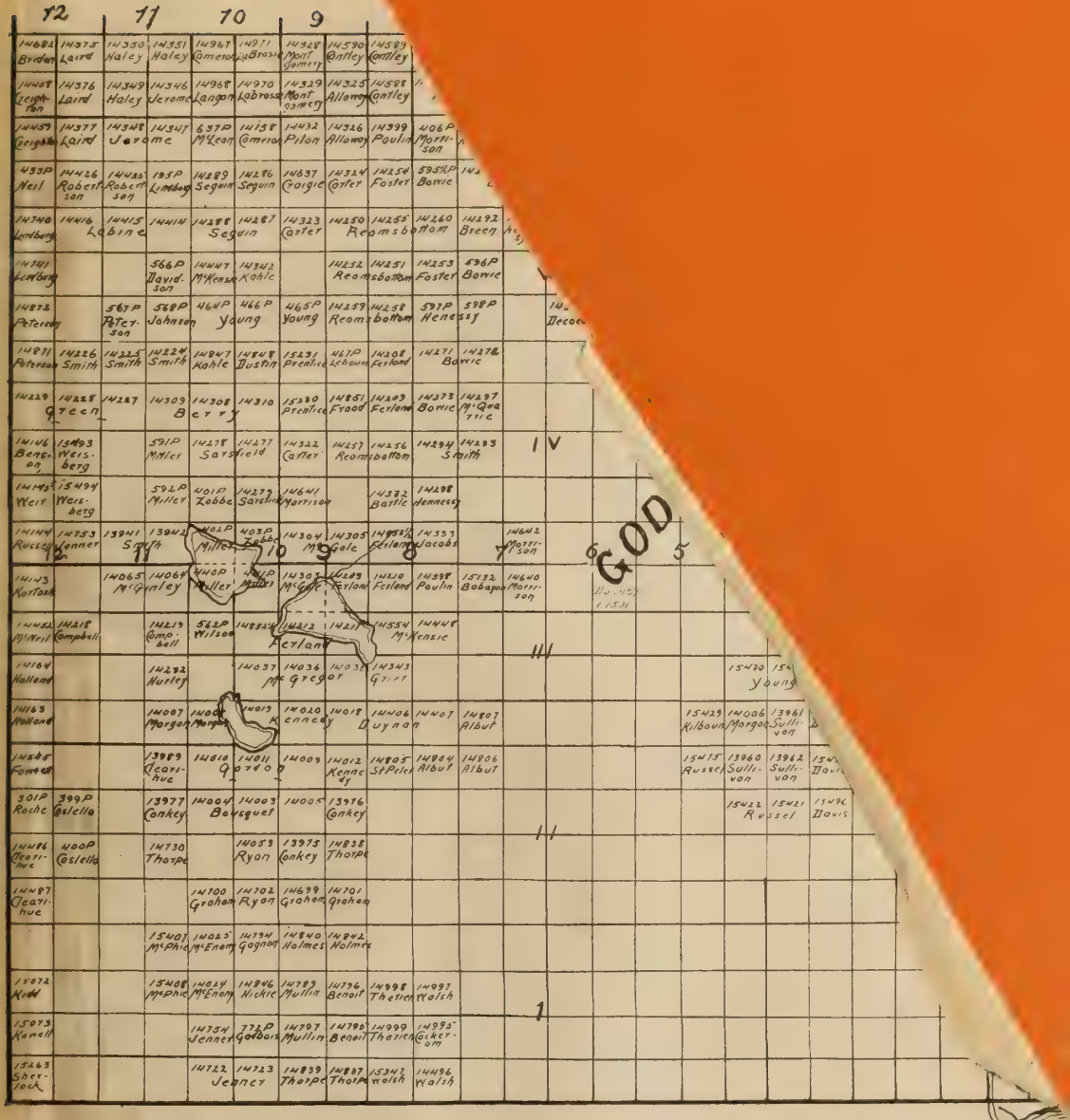
The mill, which is to be electrically driven, will be built in units of ten stamps each, four units being installed at once. A gravity plant will be obtained by making four drops from crusher to tailings discharge.

Preliminary crushing will be done in two stages, using No. 7½ and No. 5 Kennedy gyratory crushers. Belt conveyors will carry the ore to the stamp feed bins. Chalmers & Williams 1,250-pound gravity

stamps will be used with straight back rapid discharge type mortars, screen 18-mesh or coarser. The foundations will be reinforced concrete. Outside amalgamation will be adopted. Superimposed Dorr drag classifiers will be installed over tube mills of the El Oro type, which will be followed by a second set of amalgamating plates. Hydraulic cone classifiers will discharge back to tube mills and overflow to Dorr thickeners. Agitation will be accomplished in a series of continuous Pachucas. Combined thickeners and press tanks will feed to Merrill slime presses which will discharge through automatic tailing samplers.

The gold will be precipitated by the Merrill zinc-dust process. The zinc-dust will be fed to a short conveyor belt, operated by means of floats and counter-weights, at a rate proportional to the volume of solution pumped from the tank. The zinc-dust will be discharged into a mixing cone and the emulsion agitated by a jet of air. A small stream of barren solution will provide a constant overflow which will carry the emulsion down a pipe to the suction of the pump. The solution will be pumped to triangular precipitating presses, precipitation taking place entirely during the passage of the solution through the pump, pump-column, and presses. The precipitates will be acid treated, fluxed, and smelted. A fully equipped assay office, machine shop, and storehouse will be built near the mill.

Nothing has been spared in the investigation and design, and nothing will be spared in the construction and equipment to make the plant a model in every respect.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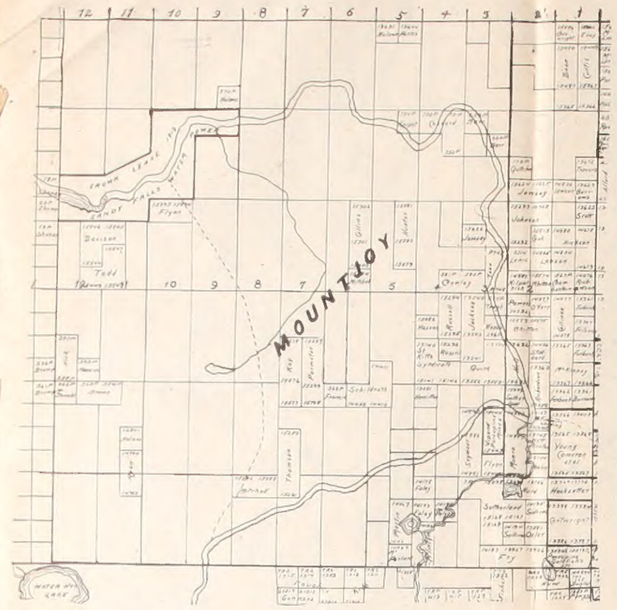
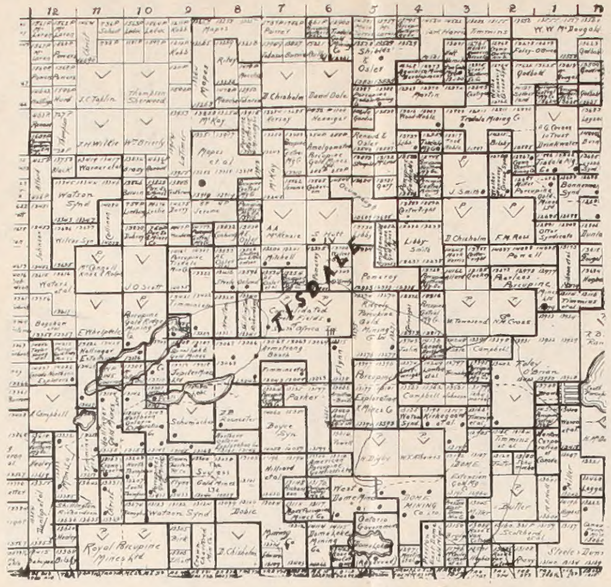
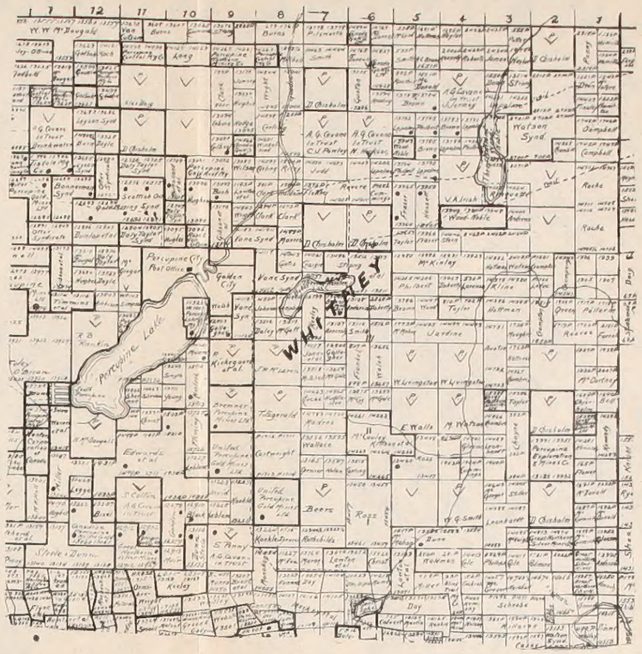
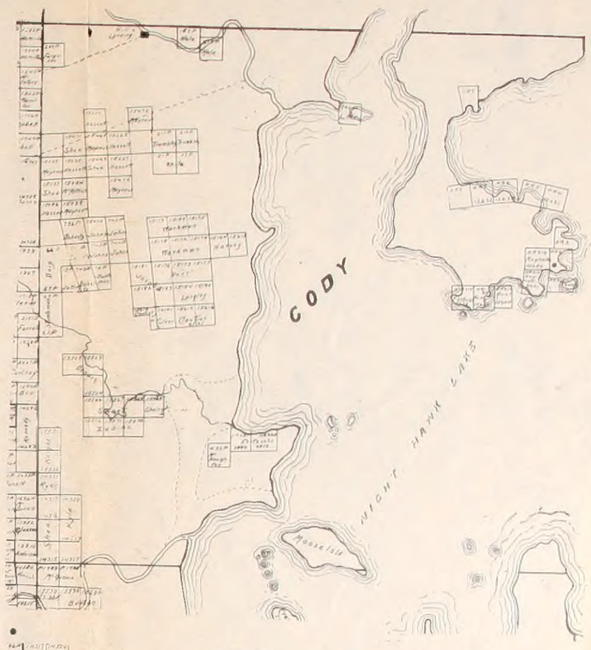
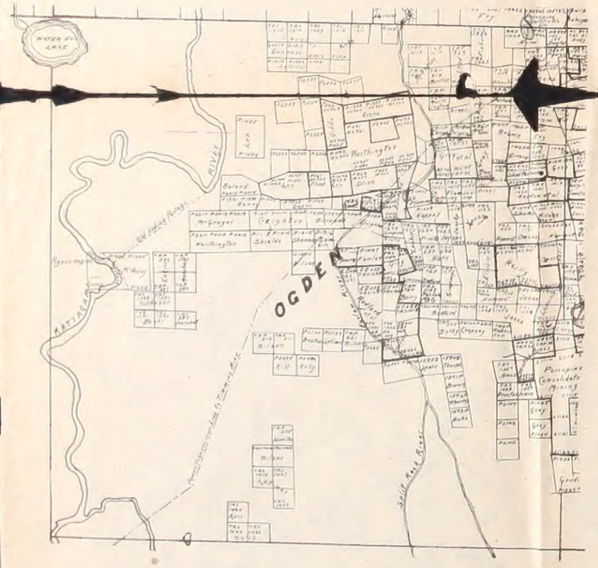
TOWNSHIP MAP PORCUPINE GOLD DISTRICT

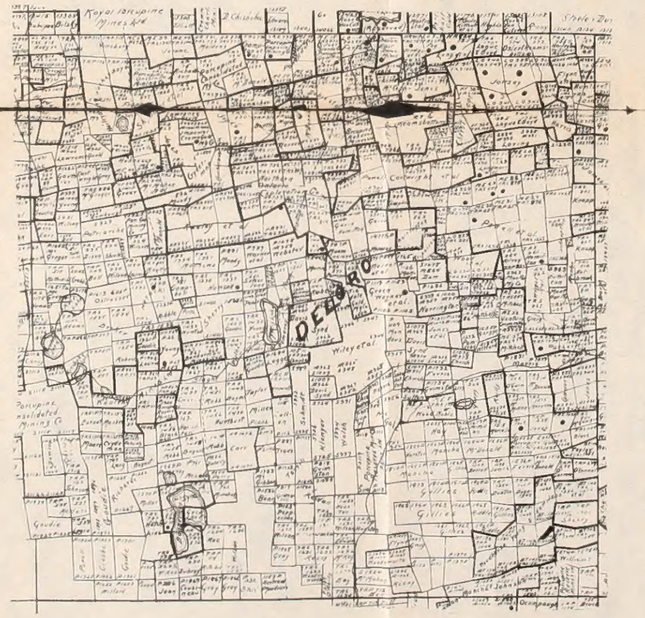


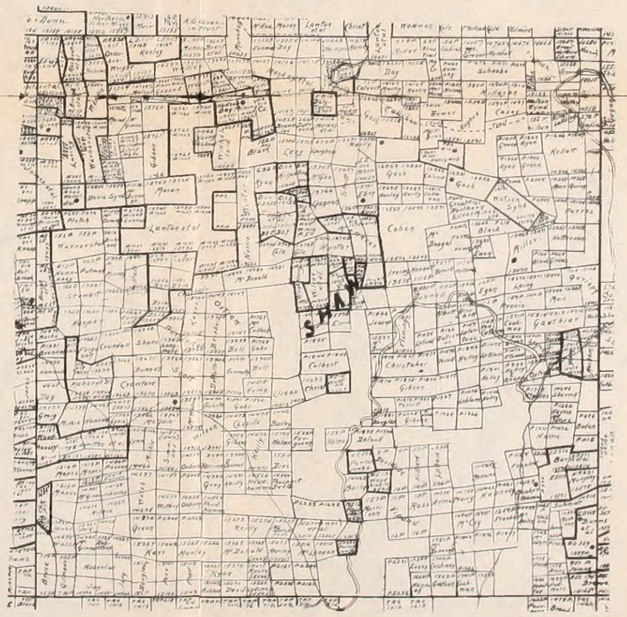


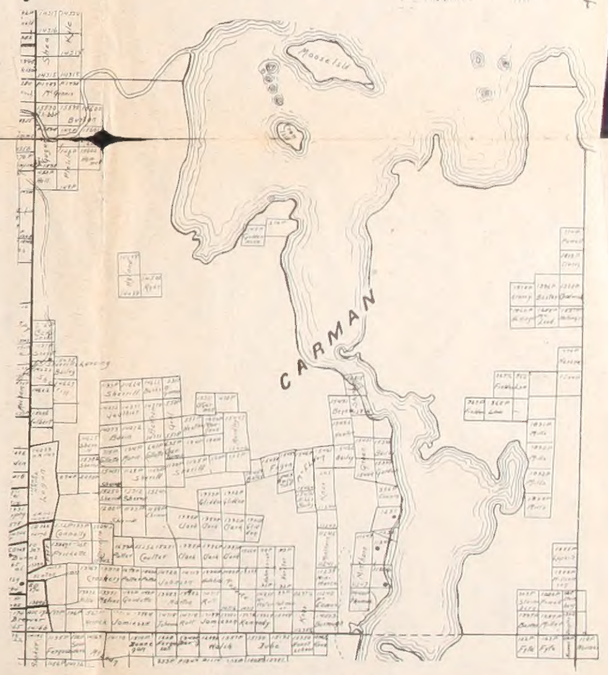


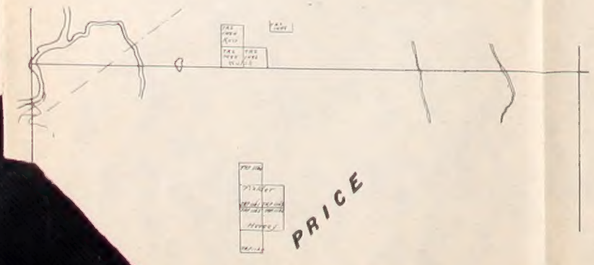


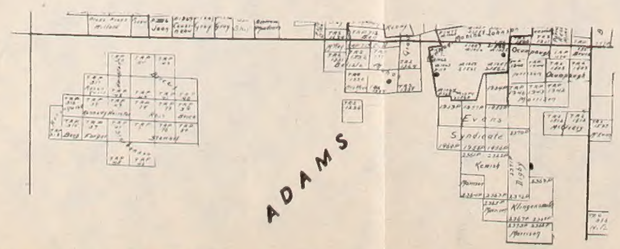


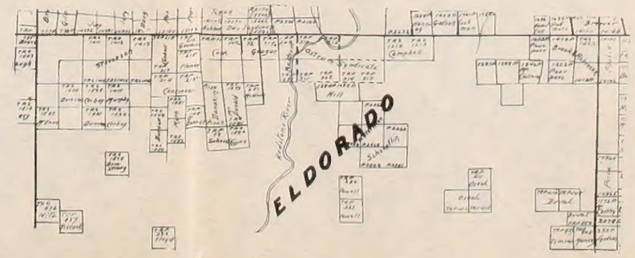




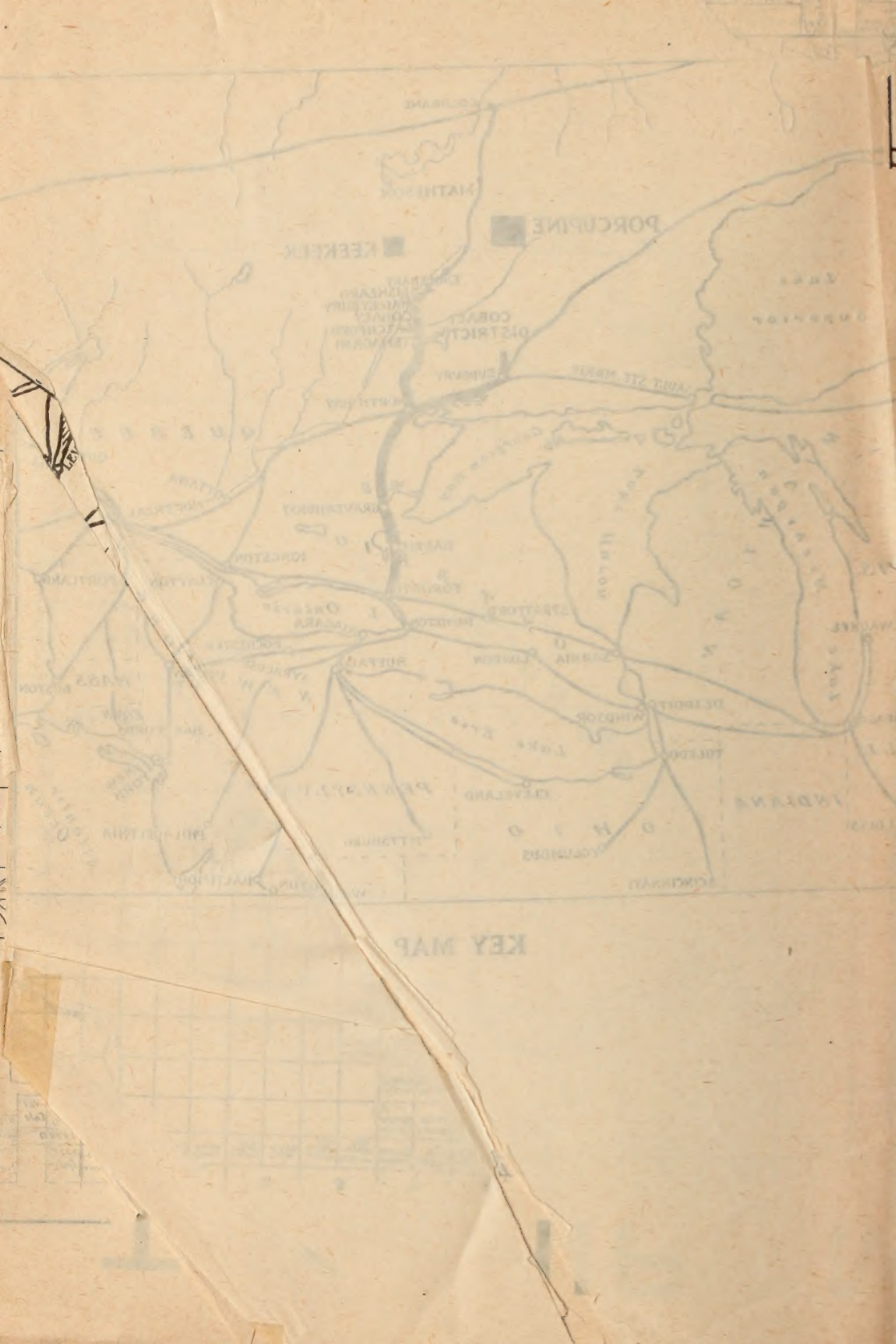








Townships are separated into individual cuts to prevent the usual confusion due to fineness of line and letter.



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